Frontier Technology, Inc.

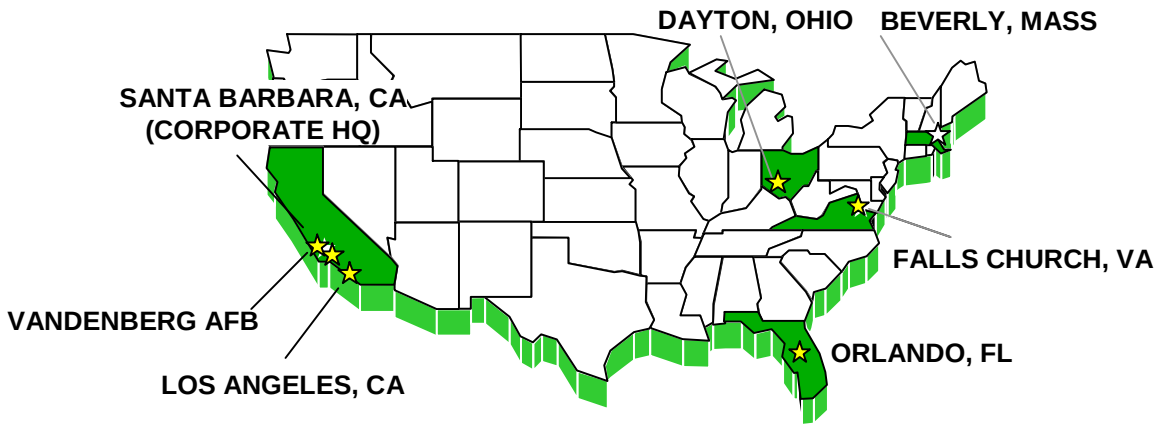
"Crafting Quality IT and Engineering Solutions"

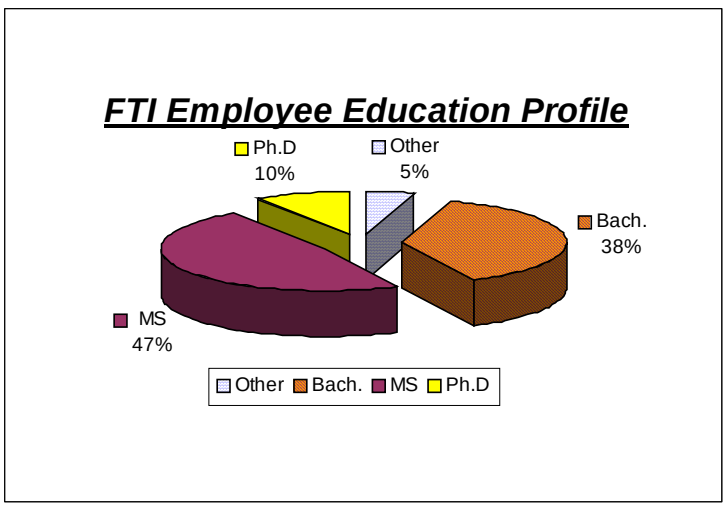
Integrated Desktop Analysis & Planning System (IDAPS) for Cost as an Independent Variable (I-CAIV)

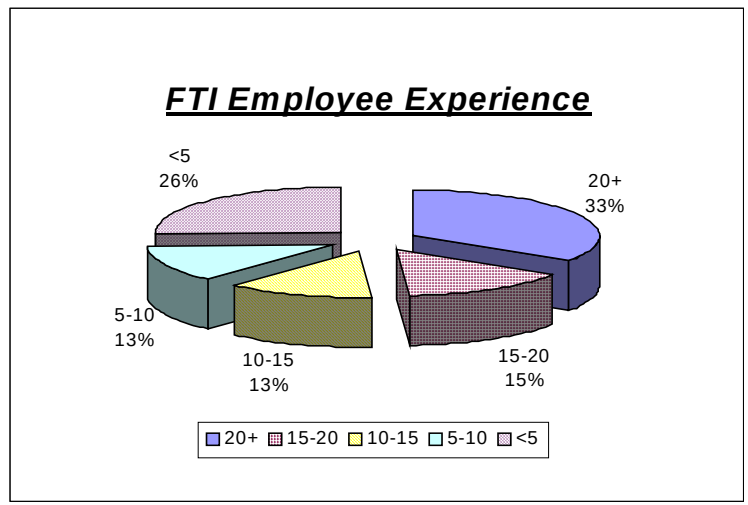
December 1999

Locations & Personnel

- **FTI Has >95 Highly Experienced Personnel Across a Wide Range of Skill Areas Close to Key Customer Locations**

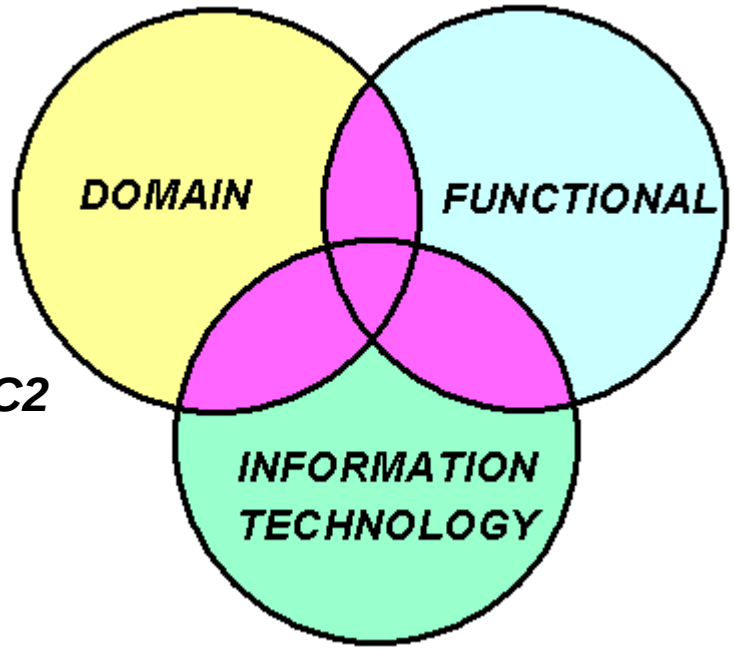






FTI Focus Areas in Defense

- *Air*
- *Space*
- *Missile Defense*
- *Intelligence*
- *Battle Management/C2*
- *Signal Exploitation*



- *Acquisition Support*
- *Ops. Research/Analysis*
- *System Engineering Requirements Analysis*
- *Operational / User Perf. Assessments*
- *Modeling, Simulation, and Analysis*
- *Signal Exploitation*
- *Experimentation / T&E and Wargaming*

- *IT Products*
  - *Automated Analysis Tools*
  - *Decision Aids*
  - *Info. Integration / Archival / Visualization / Evaluation*
  - *Integ. COTS / GOTS Solutions*
- *IT Services*
  - *Network Integration*
  - *Onsite LAN / WAN Support*
  - *Data Mining*

Sample of Current / Recent DoD Customers

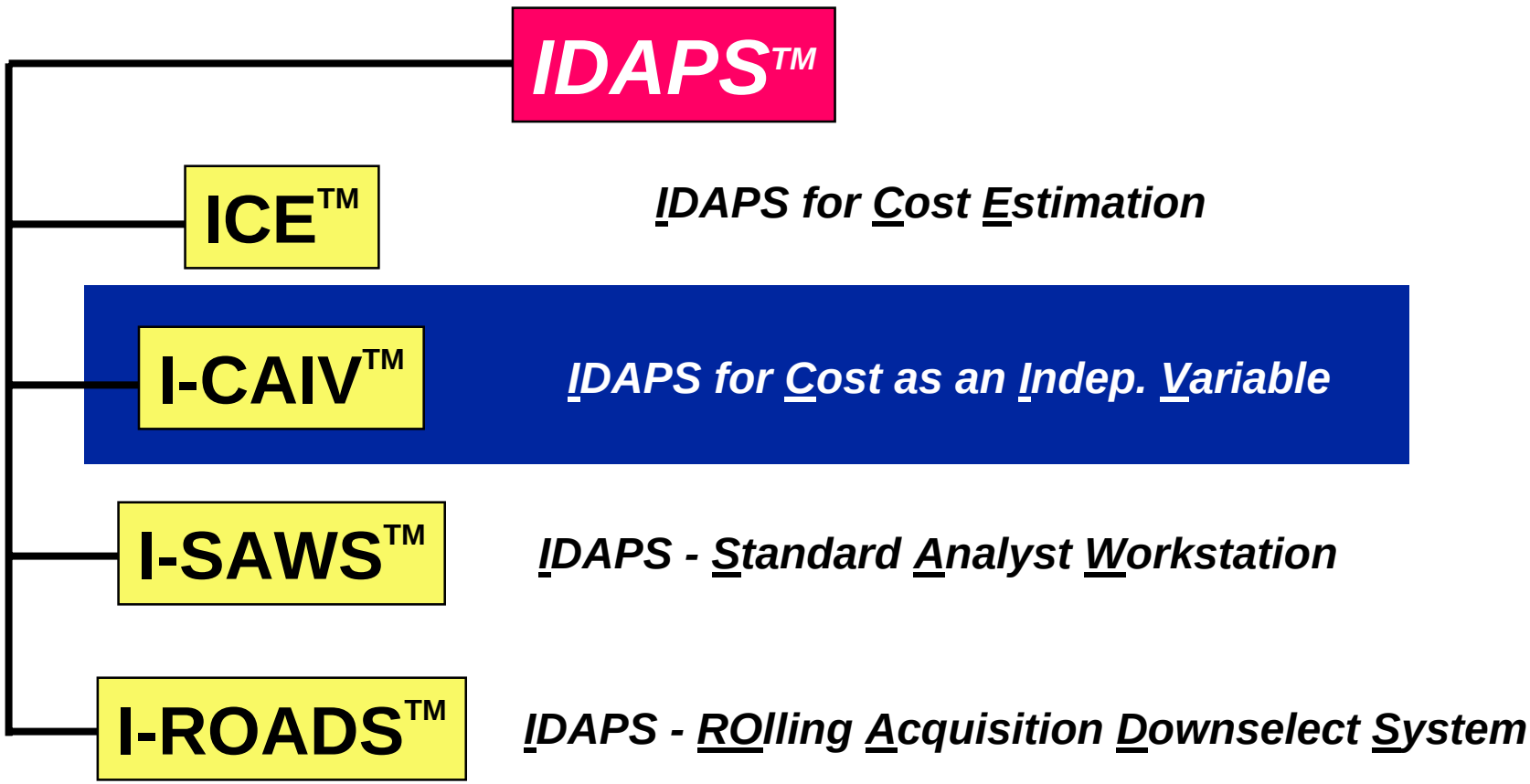
- **Ballistic Missile Defense Organization (BMDO)**
- **Joint Theater Air and Missile Defense Organization (JTAMDO)**
- **National Security Space Architect (NSSA)**
- **National Reconnaissance Office (NRO)**
- **DARPA**
- **Joint Strike Fighter (JSF) Joint Program Office (JPO)**
- **Major Aerospace Companies (TRW / Raytheon / Boeing / LMC, etc.)**
- **HQ USAF/XOC (Studies and Analyses)**
- **HQ USAF/XPX (Long Range / Strategic Planning)**
- **HQ USAF/AQ (Electronic Warfare)**
- **USAF Aeronautical Systems Center (ASC)**
- **USAF Research Labs (Wright, Rome, Phillips)**
- **USAF Electronic Systems Command (ESC)**
- **USAF Space & Missile Systems Center (SMC)**
- **USAF Vandenberg AFB**

FTI's Defense-Related Capabilities & Experience

- **Integrated Desktop Analysis & Planning System (IDAPS)**
  - **Affordability Analyses, Analytical Assessments, Acq. Support, ...**
- **Distributed / Virtual Modeling, Simulation & Prototyping Framework and Analysis Environment**
  - **MIDAS: Modular, Integrated and Distributed Analysis System**
- **C4ISR Modeling, Simulation & Analysis Capabilities**
- **FTI's Center for Space Phenomenology**
  - **Capabilities & Tools for Every Phase of Sensor Design, Development, Production, Test, and Employment**
- **Information Technology (IT) Support**
  - **Vandenberg AFB Support: 14th Air Force & 30th Space Wing**
  - **Commercial IT Products and Services**

FTI's "IDAPS" Suite of Automated Tools

Integrated Desktop Analysis and Planning System



Large, Multivariate Trade Space Demands Highly Flexible Assessment Approach

CHALLENGE

- **Consider Full Range of Alternatives:**
  - **Existing**
  - **Planned**
  - **Future**
- **Address Mix of Critical Issues:**
  - **Quantitative**
  - **Qualitative**
- **Provide Integrated & Prioritized Results**

Numerous Alternative Permutations Need Examination

Time / Resources Usually Permit Only Limited Assessment!

Evaluation Options:

1. **"BOGSAT"**
2. **Operational Experience**
3. **Quick Response Analysis**
3. **Legacy Model Analysis**

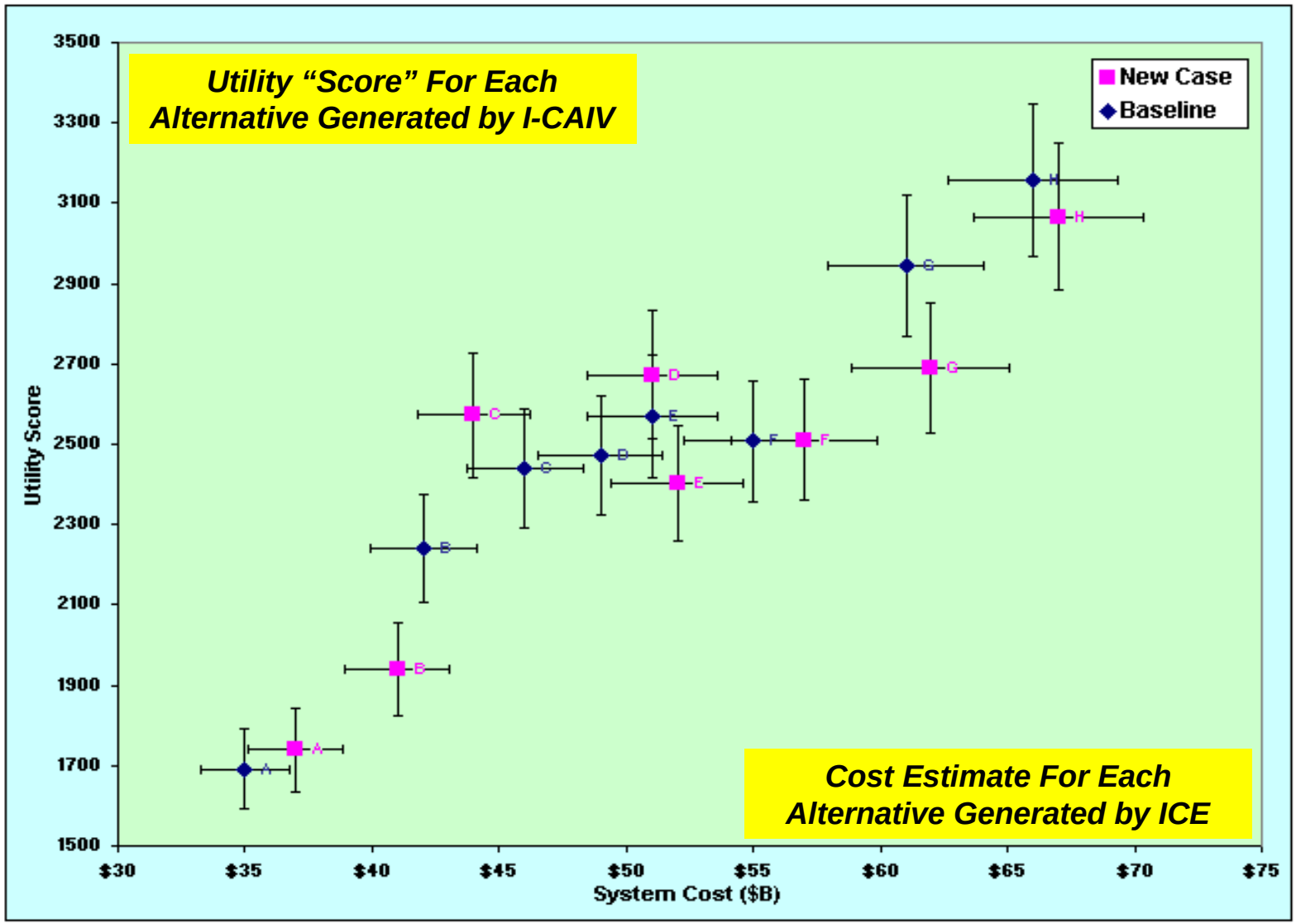
Analysis / Assessment Must Be:

- **Timely**
  - **Accurate**
    - **Relevant**
      - **Objective**
        - **Understandable**

CAIV is a DoD Requirement for ALL Acquisition Programs

- ***CAIV*** **is the Primary acquisition process strategy for meeting Warfighter requirements while Reducing Total Ownership Costs (RTOC).**
- **It is, as defined by DoD 5000 & AFI 10-601 (10/1/98) defined as: "The process of using better business practices, allowing "*Trade Space*" for industry to meet user requirements, and considering operations and maintenance costs early in requirements definition in order to procure systems smarter and more efficiently"**
- ***CAIV Analysis is REQUIRED*** **for all DoD Acquisition Programs**
  - **Linked to Several Defense System Affordability Council (DSAC) / Dr. Gansler Goals**

Goal: Establish Disciplined Process & Automated Tool for CAIV Profile Generation



Near Term CAIV

New Case

Requirements
All

Requirement Priority
Steering Group

MOEs
All

Initial Conditions
All

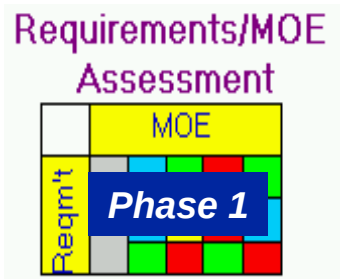
Analysis Model
CAPS

Cost Data
Indept. Eval. (ICE)

IDAPS for Cost as an Independent Variable "I-CAIV"

STUDY MEASURES OF EFFECTIVENESS (MOEs)

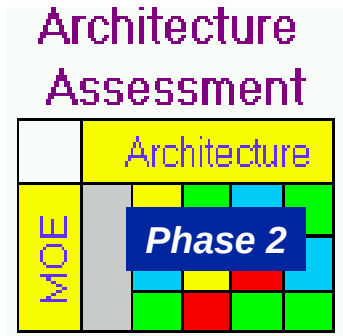
USER REQMTS.



PRIORITIZED MOEs

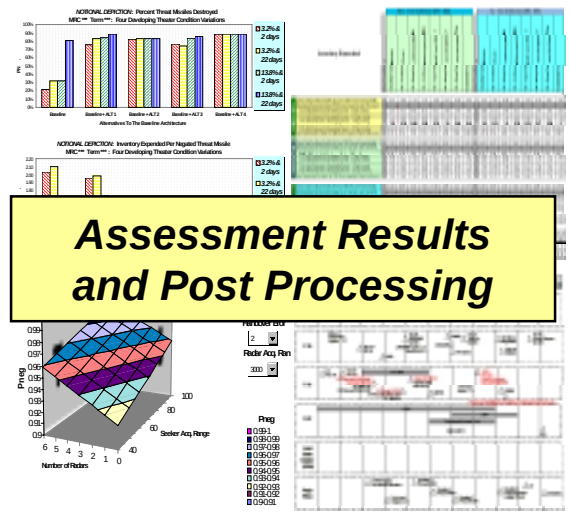
ARCH. / SYSTEM / TECHNOLOGY ALTERNATIVES

PRIORITIZED MOEs

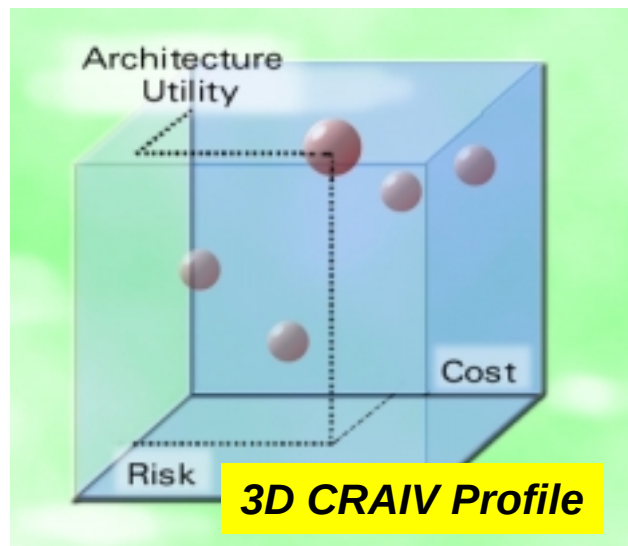


RISK

UTILITY "SCORE"



Assessment Results and Post Processing



3D CRAIV Profile

Simplified View of I-CAIV Assessment Process Provides Ranking of Assessment Alternatives Traceable to User Needs / Requirements

I-CAIV Functionality Overview

- **Mission / Requirements Prioritization**
  - Establish Formal Link to User / Warfighter Needs
- **MOE / Attribute Prioritization**
  - "Shred" Requirements to Identify MOE(s) for Each
- **Analysis of Alternatives (AoA)**
  - Import and Archive Analysis Results In Data Base
  - Apply Analysis Results for each MOE
  - Use "Utility Curves" to Translate Analysis Results Into I-CAIV Scoring Roll-up Matrix Format
  - Tool Integrates Range of Data to Form "Utility" Score
- **Sensitivity Analysis Capabilities**
  - Requirements Prioritization
  - Threat / Scenario / Initial Condition Threads
  - Alternative Robustness for Each MOE
  - Alternate Cost Estimations, etc.

I-CAIV Process – Phase 1
Requirements and MOE Prioritization

2 Steps in Phase 1:

- User / Warfighter Requirements Prioritization
- MOE Definition and Prioritization

Phase 1 Output:

- Prioritized MOEs Linked to User Requirements for Assessment of Alternatives (AoA)

Requirements/MOE Assessment

Phase 1
Mission / Requirements / MOE Prioritization

TMD COEA Issues	Importance	Architecture	Threat Missi	Inventory Ex	Shots Per Ki	Depth of Fire	Deployment
TMD Architecture and Cost Effectiveness	1.89	7.00	7.00	7.00	7.00	7.00	7.00
Affordability	1.25	9.00	7.00	9.00	7.00	7.00	9.00
TMD Against WMD	2.09	10.00	10.00	4.00	7.00	9.00	9.00
Urgency of Rqmts & Priorities	0.60	7.00	7.00	4.00	4.00	4.00	0.00
Relative Mission Priorities	0.49	7.00	7.00	4.00	4.00	0.00	4.00
Inventory	0.88	9.00	9.00	10.00	7.00	0.00	7.00
UOES	0.35	9.00	9.00	1.00	1.00	4.00	1.00
Effects of Sensors on Alternative Mixes	0.91	10.00	10.00	7.00	7.00	7.00	0.00
C41 / Battle Management	1.05	9.00	7.00	7.00	4.00	0.00	4.00
International Cooperation	0.49	7.00	7.00	0.00	0.00	0.00	0.00
Absolute Importance		[illegible].05	81.44	60.09	58.06	50.97	56.02
Relative Import. %		0.22	0.21	0.15	0.15	0.13	0.14

I-CAIV Process: Phase 2
- Assessment of Alternatives (AoA) -

- **Prioritized MOEs Translate From Phase 1**
  - **Tool Framework Automates Flow**
- **Analysis of Alternatives vs. MOEs Captured in dBase**

Phase 2 AoA Matrix

TMD Measures of Effectiveness / TMD Alternate Architecture Candidates		Far Term							
		e (BL)		nse (NAD)	ceptor (ABI)	BL + Space-Based Laser (SBL)	BL + Navy Theater Wide (NTW)	BL + Navy Theater Wide Endo/Exo	BL + NAD + NTW
Architecture Engagement Opportunities	0.22	4.58	6.25	7.51	7.52	8.15	8.36	8.75	8.75
Threat Missiles Destroyed	0.21	4.25	4.37	4.58	4.27	4.58	4.91	5.23	9.03
Inventory Expended	0.15	5.32	8.75	5.75	9.06	9.03	6.61	6.59	6.11
Shots Per Kill	0.15	4.58	6.89	6.25	7.51	7.52	8.15	8.36	7.70
Depth of Fire	0.13	5.75	9.06	4.37	4.58	4.27	5.32	8.75	9.06
Deployment Quantities	0.14	5.32	8.75	5.75	9.06	9.03	6.61	6.59	6.11
Architecture Utility		2.51	3.26	2.75	3.38	3.44	3.23	3.33	3.28

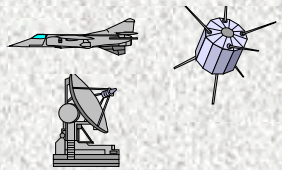
- **Analysis Results Assessed vs. Reqmts. To Determine Alternative vs. MOE "Score"**
  - **"Utility Curves" Employed To Translate Analysis Results to Score Based on Warfighter Requirements**

I-CAIV Process: Phase 2
- Apply Analysis Data in CAIV Process -

Evaluation / Assessment Criteria Considerations

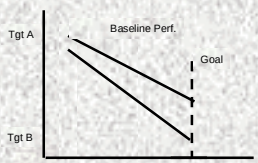
Threats / Scenarios

System Parameter Descriptions



Programmatic, Politics, etc.

"Utility Curves" Traceable to Requirements



Data / Models / Simulations Capabilities

"RELATIONSHIP MATRIX" QUANTIFIES HOW WELL EACH ARCH. ALTERNATIVE ADDRESSES EACH MOE

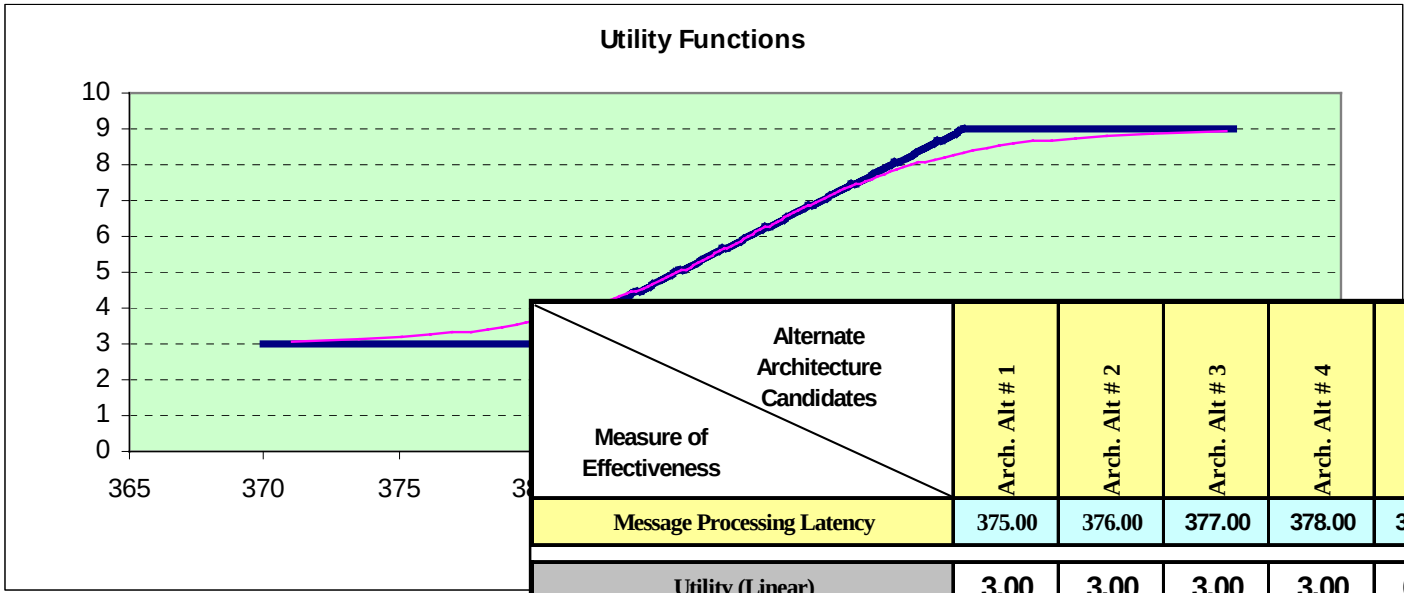
ARCHITECTURE ALTERNATIVES

TMD Alternate Architecture Candidates	Far Term							
	BL + Air-Based Interceptor (ABI)	BL + Space-Based Laser (SBL)	BL + Navy Theater Wide (NTW)	BL + Navy Theater Wide Endo/Exo	BL + NAD + NTW			
		8.15	8.36	8.75	8.75			
			4.91	5.23	9.03			
	9.06	9.03	6.61	6.59	6.11			
	6.25	7.51	7.52	8.15	8.36	7.70		
0.13	4.37	4.58	4.27	5.32	8.75	9.06		
0.14	5.75	9.06	9.03	6.61	6.59	6.11		
Architecture Utility	2.75	3.38	3.44	3.23	3.33	3.28		

ARCHITECTURE UTILITY SCORE

- **Trades and Analyses Results Accessed via Data Base and Used in Tool to "Score" Arch. Alternatives vs. Utility Curves Based on Thresholds / Objectives**
- **Prioritized MOEs Combined With Analysis Results Provide Aggregated "Architecture Utility" Score for Use in CAIV Profile Development**

MOE-Specific "Utility Curves" Translate Arch. Analysis Results to ICAIV Framework



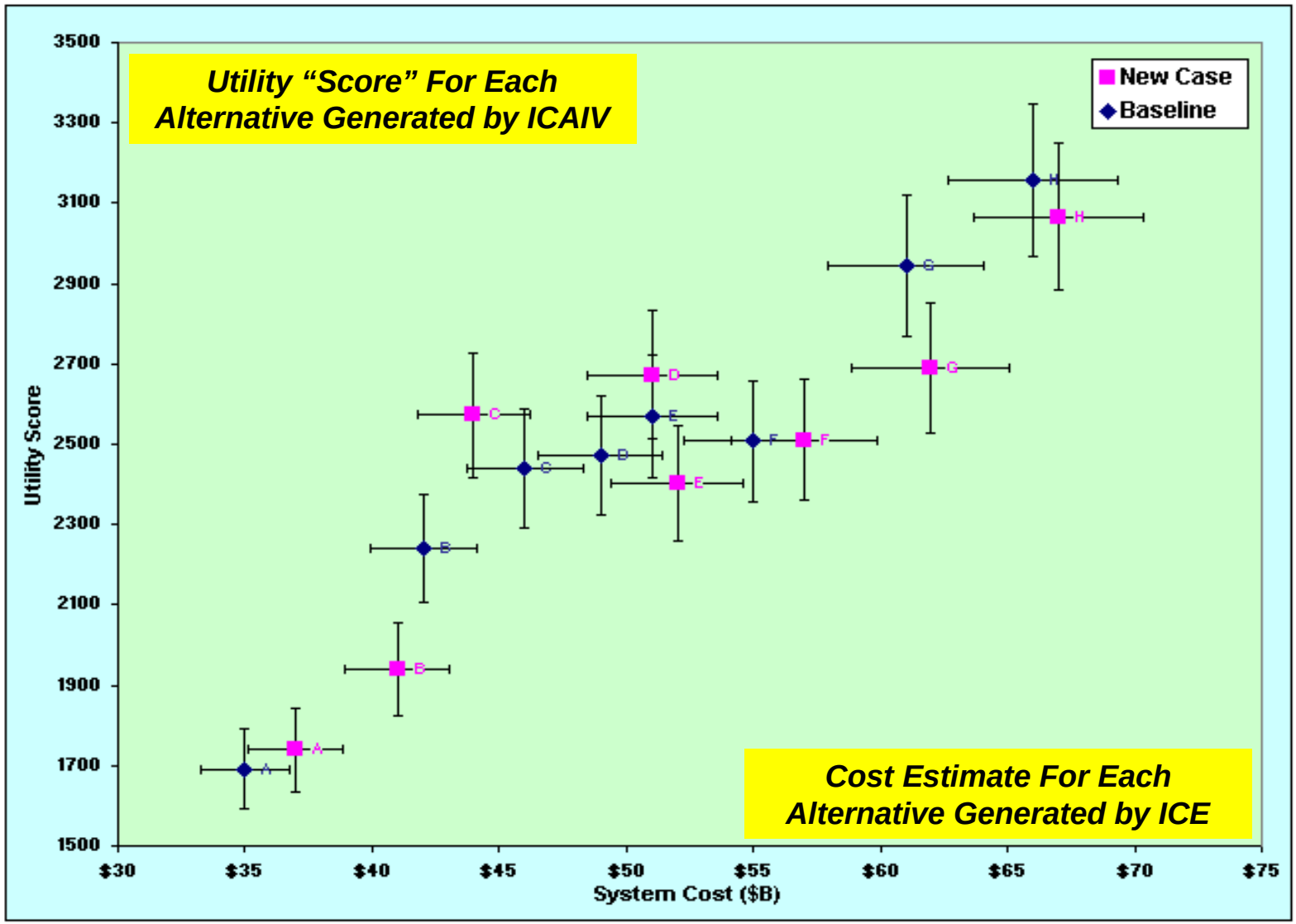
Evaluation Criteria	
Objective:	396
Threshold:	380

Scaling Factors	
Objective:	9
Threshold:	3

Measure of Effectiveness \ Alternate Architecture Candidates	Arch. Alt # 1	Arch. Alt # 2	Arch. Alt # 3	Arch. Alt # 4	Arch. Alt # 5	Arch. Alt # 6	Arch. Alt # 7	Arch. Alt # 8
Message Processing Latency	375.00	376.00	377.00	378.00	388.00	380.00	390.00	382.00
Utility (Linear)	3.00	3.00	3.00	3.00	6.00	3.00	6.75	3.75
Utility ("S" Curve)	3.18	3.23	3.30	3.39	6.01	3.63	6.78	4.01

- **"Utility Curve" Generated for <u>Each</u> MOE to Translate Analytical Results for Each Alternative to the Common Architecture Evaluation Framework**
- **"Utility Curve" Reflects Warfighter Utility in Represented Function … Shows Sensitivity Between or Beyond Objective and Threshold Requirement Levels**
- **I-CAIV Tool Automates Application of Analysis Results to Assessment Process via Utility Curve Interpolation … Scores Migrated to Framework**

Life Cycle / Unit Costs Integrated With Architecture Utility to Form CAIV Profile



Near Term CAIV

New Case

Requirements
All

Requirement Priority
Steering Group

MOEs
All

Initial Conditions
All

Analysis Model
CAPS

Cost Data
Indept. Eval. (ICE)

CRAIV Profile Integrates Utility + Cost + Risk to Form Comprehensive Decision Trade Space

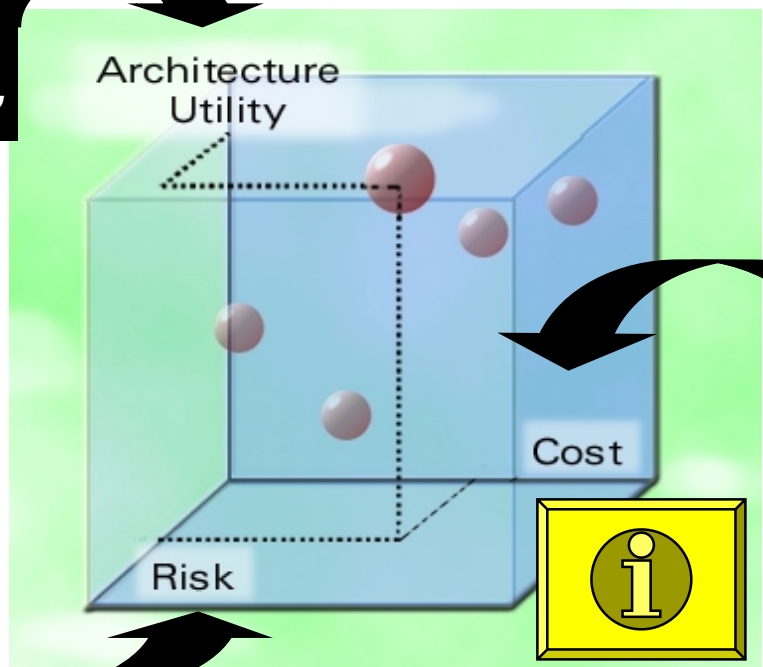
ARCHITECTURE ALTERNATIVES

PRIORITIZED ARCHITECTURE MOEs

Architecture MOEs vs. Alternatives

ARCHITECTURE UTILITY "SCORE"

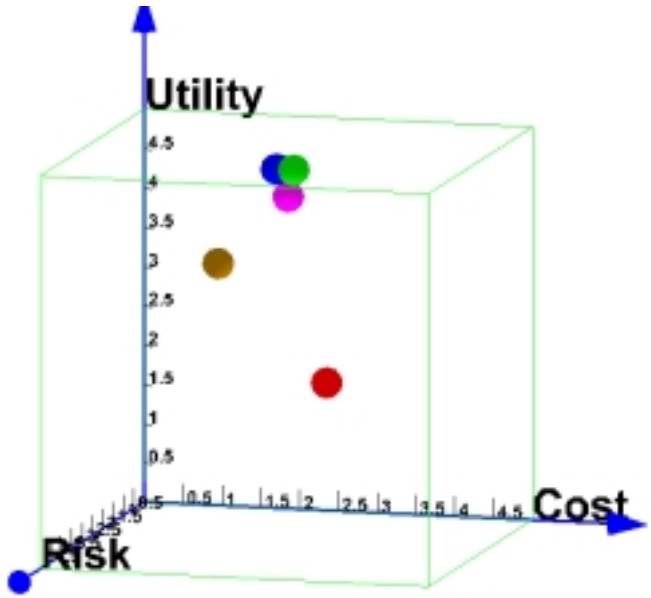
I-CAIV Tool Automates Process and Provides "Dynamic" 3-D CRAIV Profile for Real-time Sensitivity Analyses Throughout Spiral Development Process

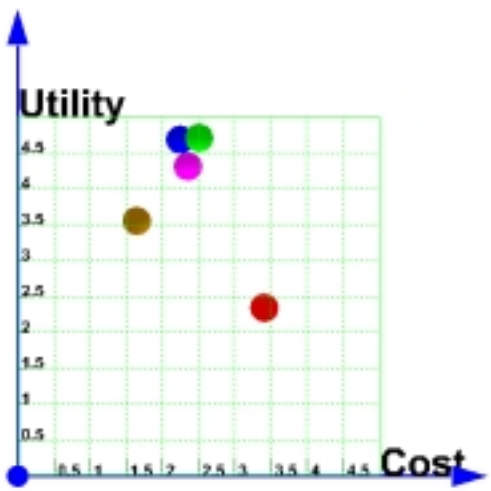


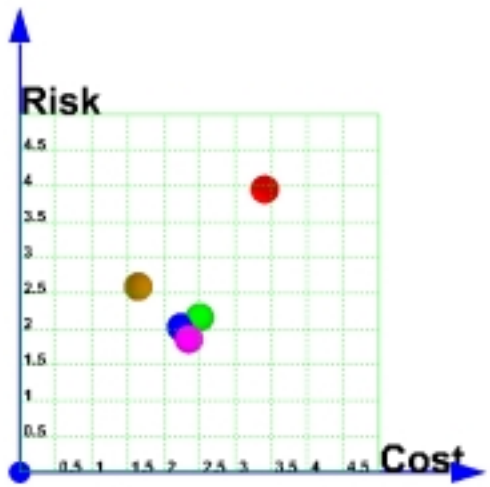
Architecture Risk Assessment Results

Architecture Cost / R-TOC Analysis Results

I-CAIV Output is Dynamic CRAIV 3-D Decision Space for Arch. Assessment







- **Cost and Risk as Independent Variables (CRAIV)**
- **3-D Decision Space Allows User to View All Key Aspects**
- **PC-Based Tool Allows Dynamic "What-Ifs" Within Decision Space**
- **Full Range of Analysis and Prioritization Data Is Archived in Tool**

The AoA Process is Captured and Automated in FTI's I-CAIV Tool

Missions / Rqmts.
Define / Extract Missions & Requirements to Lowest Measurable Metrics

Measures of Effectiveness (Develop a Complete Inventory of MOEs From Requirements

Mission / Rqmts. Prioritization
Leverage IPT Process to Facilitate the Prioritization Of Missions & Requirements to Link to AoA Process

Requirements/MOE Criteria Development
Develop Criteria to Assess How Strongly MOEs Correlate With Each Requirement

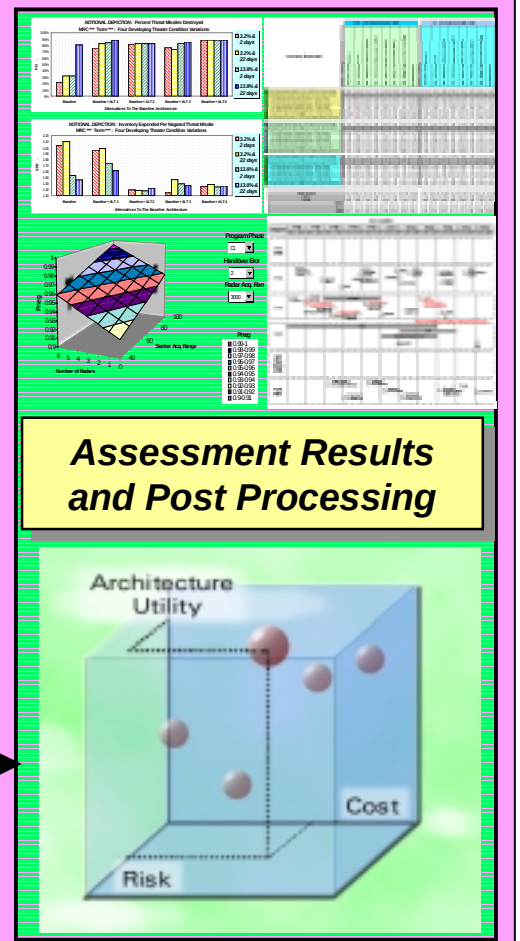
Requirements/MOE Assessment
Assess How Strongly MOEs Correlate With Requirements Using Above Criteria

Compute MOE Scores
Weighted MOE Scores are Computed by Combining Values From Requirements-to-MOE Assessments and Requirements Prioritization

Analysis Results
Develop Requirements-Driven Criteria to Evaluate and Normalize Raw Analysis Results

Utility Assessment
Assess Alternative's Utility Across All MOEs Using Normalized Results for ALL Initial Conditions

Requirements-Based Architecture Assessment
Assess Utility Across Architectures Weighted By Requirements-Driven MOE Scores to Produce CAIV Profiles



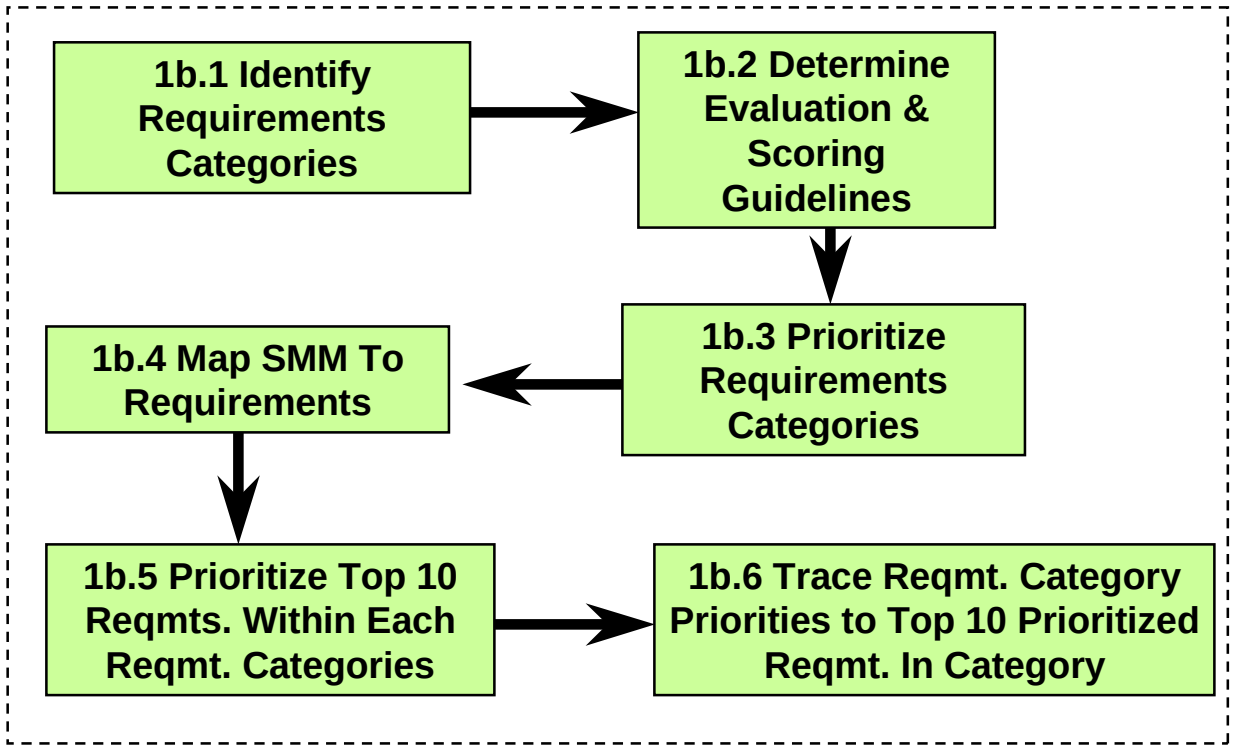
I-CAIV Process Captured in IDEF 0 Format

CONSTRAINTS:

- **Too Many Requirements for Available Time & Resources in Proposal**
- **No Current Customer Involvement in Process**

INPUTS:

1. **Prioritized Mission Areas From 1.0**
2. **SMM**
3. **CRD**



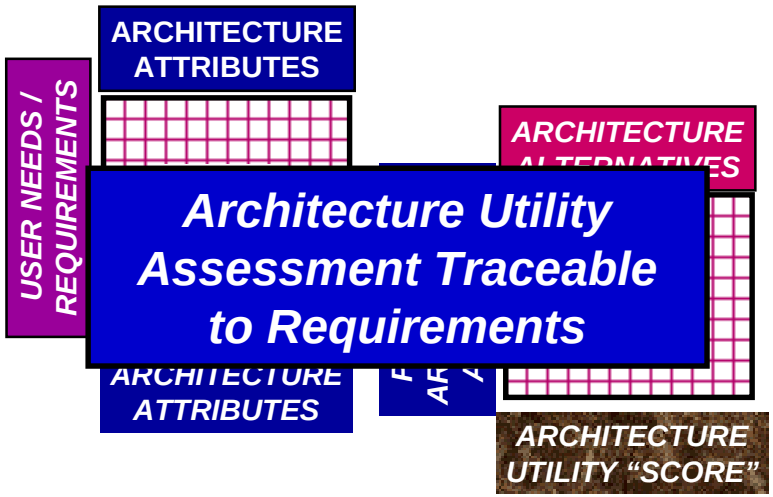
OUTPUTS:

- **Prioritized Requirements Categories**
- **Top 10 Prioritized Requirements in Each Category**
- **Voting Statistics**
- **Data Base of Requirements Prioritization Results for I-CAIV Tool**

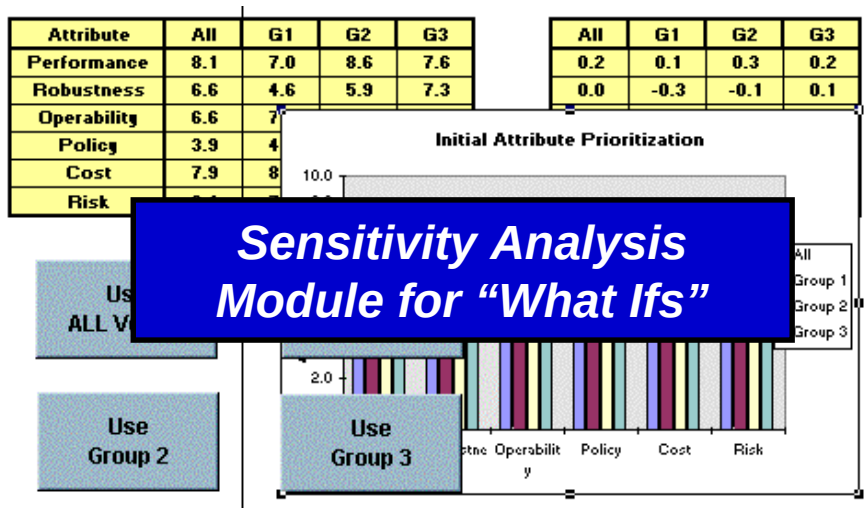
MECHANISMS:

- **Requirements IPT Members & Other Selected "Experts" for Voting**
- **FTI's I-CAIV Process and Tool**

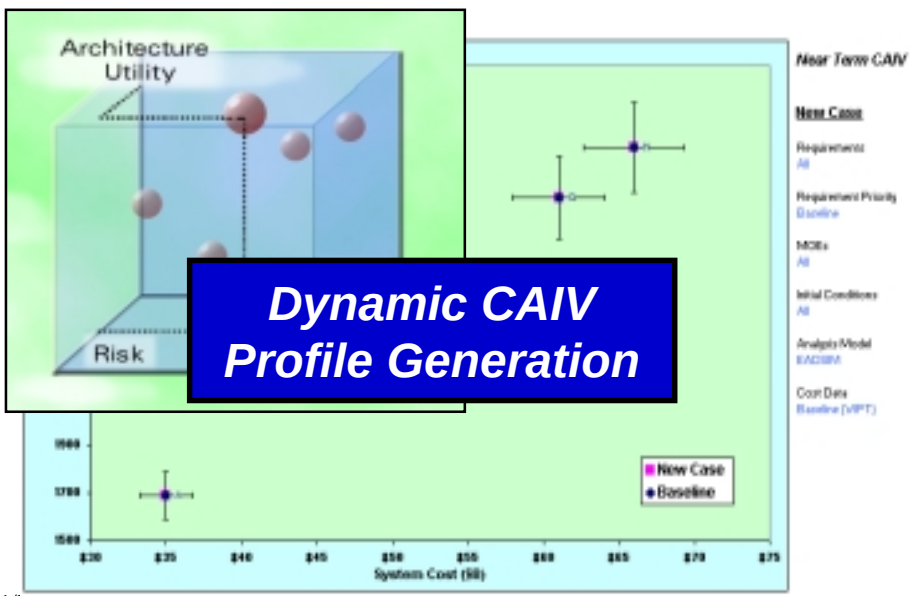
FTI's "I-CAIV" Tool Provides Array of Automated Process Functions



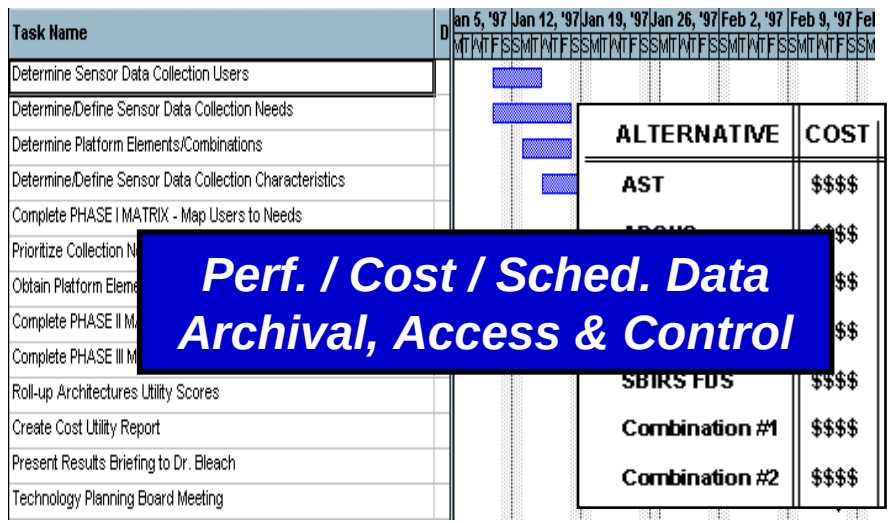
Architecture Utility Assessment Traceable to Requirements



Sensitivity Analysis Module for "What Ifs"



Dynamic CAIV Profile Generation



Perf. / Cost / Sched. Data Archival, Access & Control

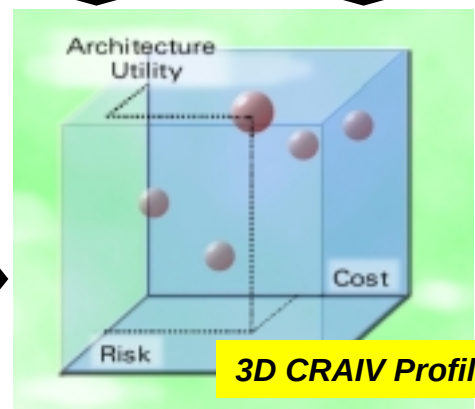
Robust I-CAIV Application Includes Current Capability Assessment Linked to AoA

Analysis of Alternatives (AoA)

- PRIORITIZED MISSIONS
- REQUIREMENTS
  - Missions vs. Requirements
  - Phase 1
- PRIORITIZED REQUIREMENTS
- ARCHITECTURE MOEs
  - Requirements vs. MOEs
  - Phase 2
- PRIORITIZED ARCHITECTURE MOEs
- ARCHITECTURE ALTERNATIVES
  - Architecture MOEs vs. Alternatives
  - Phase 3
- PRIORITIZED REQUIREMENTS
- PRIORITIZED MOEs
- ARCHITECTURE UTILITY "SCORE"

RISK

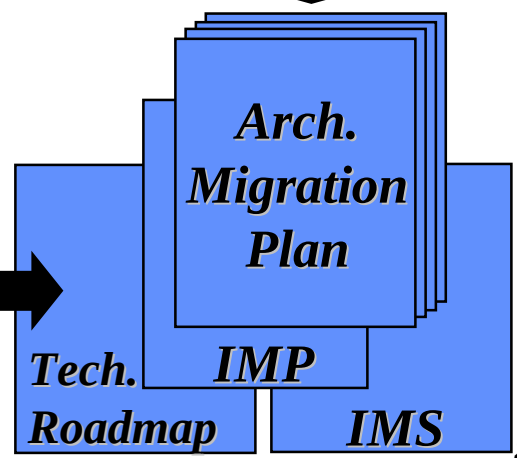
COST



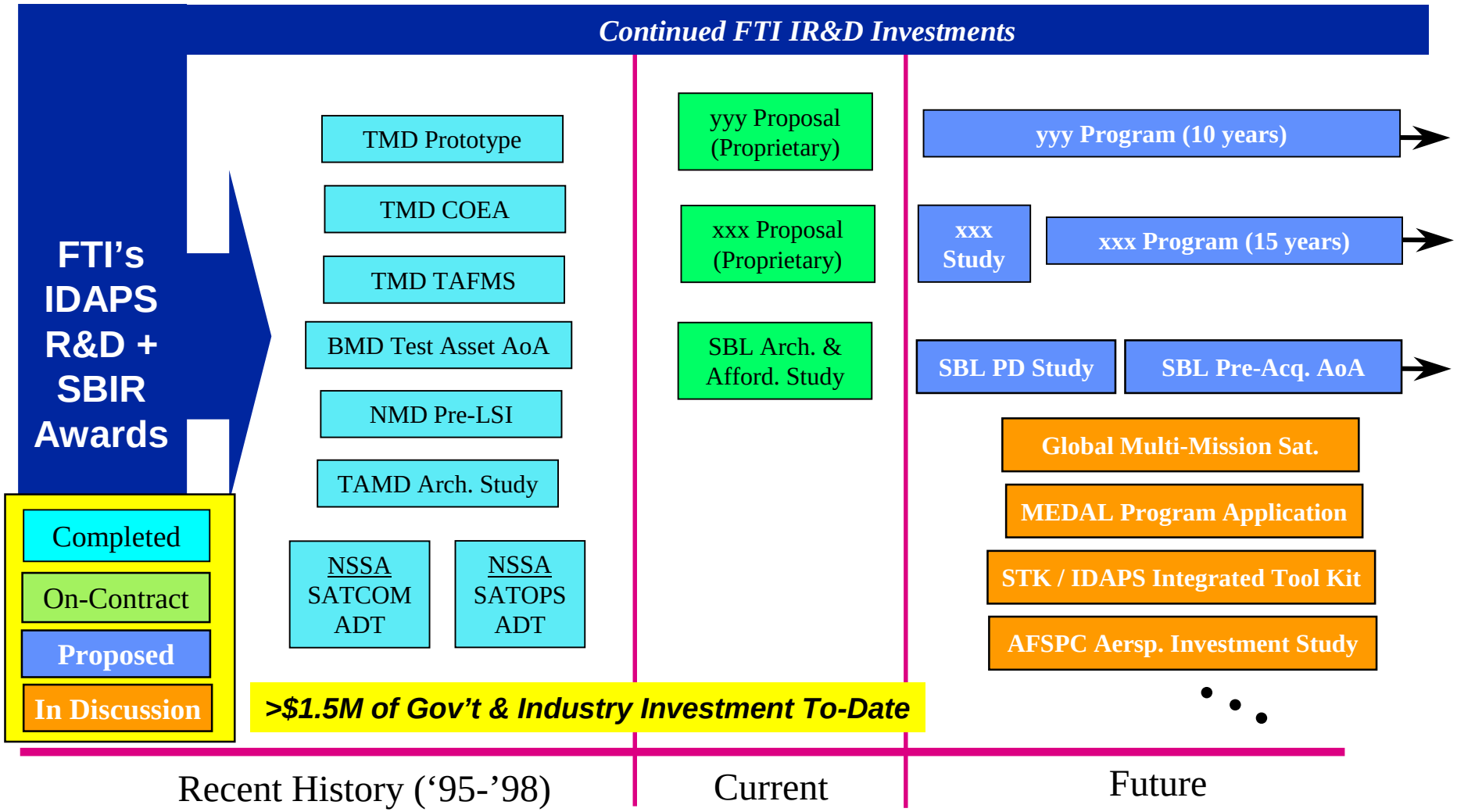
3D CRAIV Profile

Current Capability Assessment

- PRIORITIZED REQUIREMENTS
- "AS IS" DEFICIENCIES
  - Requirements vs. Deficiencies
  - Phase 4
- PRIORITIZED "AS IS" DEFICIENCIES
- PRIORITIZED DEFICIENCIES
- RESOLUTION CONCEPTS
  - Deficiencies vs. Resolution Concepts
  - Phase 5
- PRIORITIZED CONCEPTS
- TECHNOLOGIES & PRODUCTS
  - Concepts vs. Technologies & Products
  - Phase 6
- PRIORITIZED TECHNOLOGIES & PRODUCTS



I-CAIV Process / Tool Application History
- Continued Growth & Commercialization -

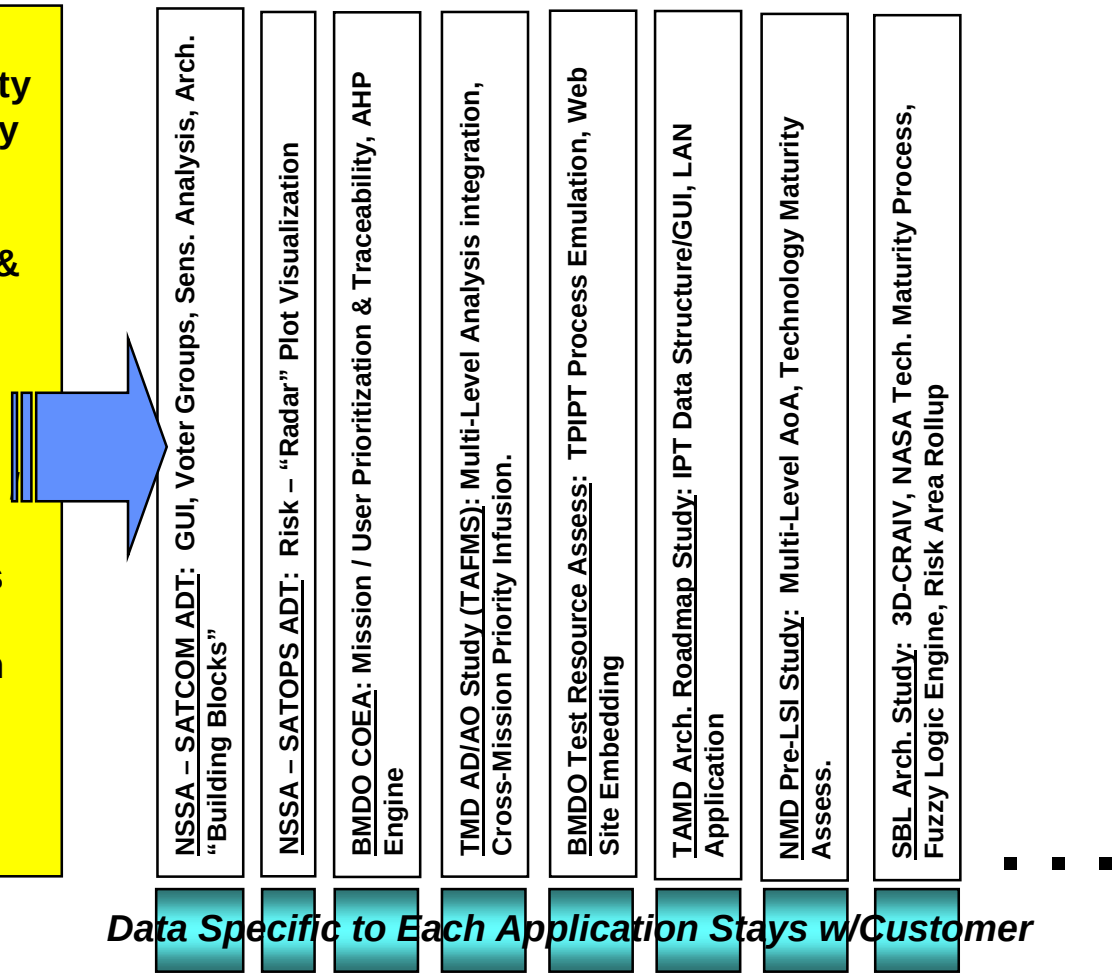


I-CAIV Development & Application History

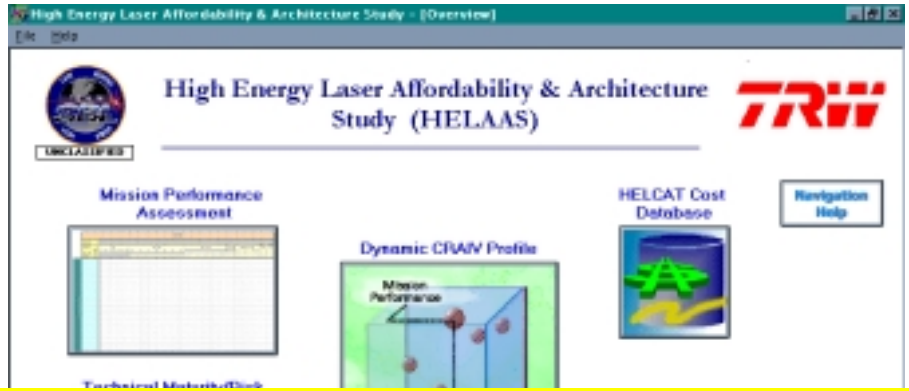
Baseline Capability Applied to I-CAIV Variants … Improvements Leveraged to Current / Future Applications Where Applicable

I-CAIV PROCESS / *PRODUCT*

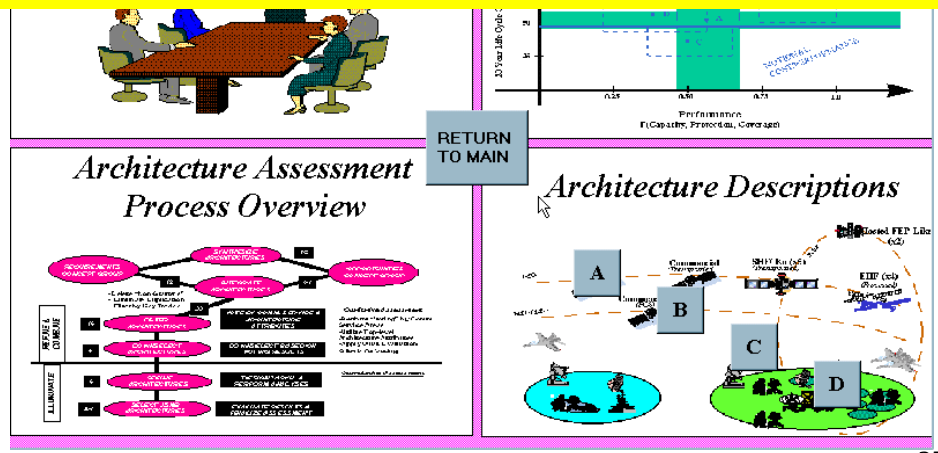
- Mission Prioritization / Traceability
- Reqmt. Prioritization / Traceability
- MOE Prioritization / Traceability
- Analysis Results dBases
- Military Utility Curve Generation & Application
- Apply MOE Analysis vs Utility Curves to "Score" Alternatives
- Study Data Archival & Control
- Key Variable Sensitivity Analysis What If Assessments
- GUI Interface to I-CAIV Functions
- Data Visualization Options
- Dynamic CAIV Profile Generation
- Addn of Risk to I-CAIV via 3-D "CRAIV" Profile
- Technology Maturity Assess. Via USAF TPIPT Process Emulation



I-CAIV Tool Provides Turn-Key, Integrated Study Information Environment



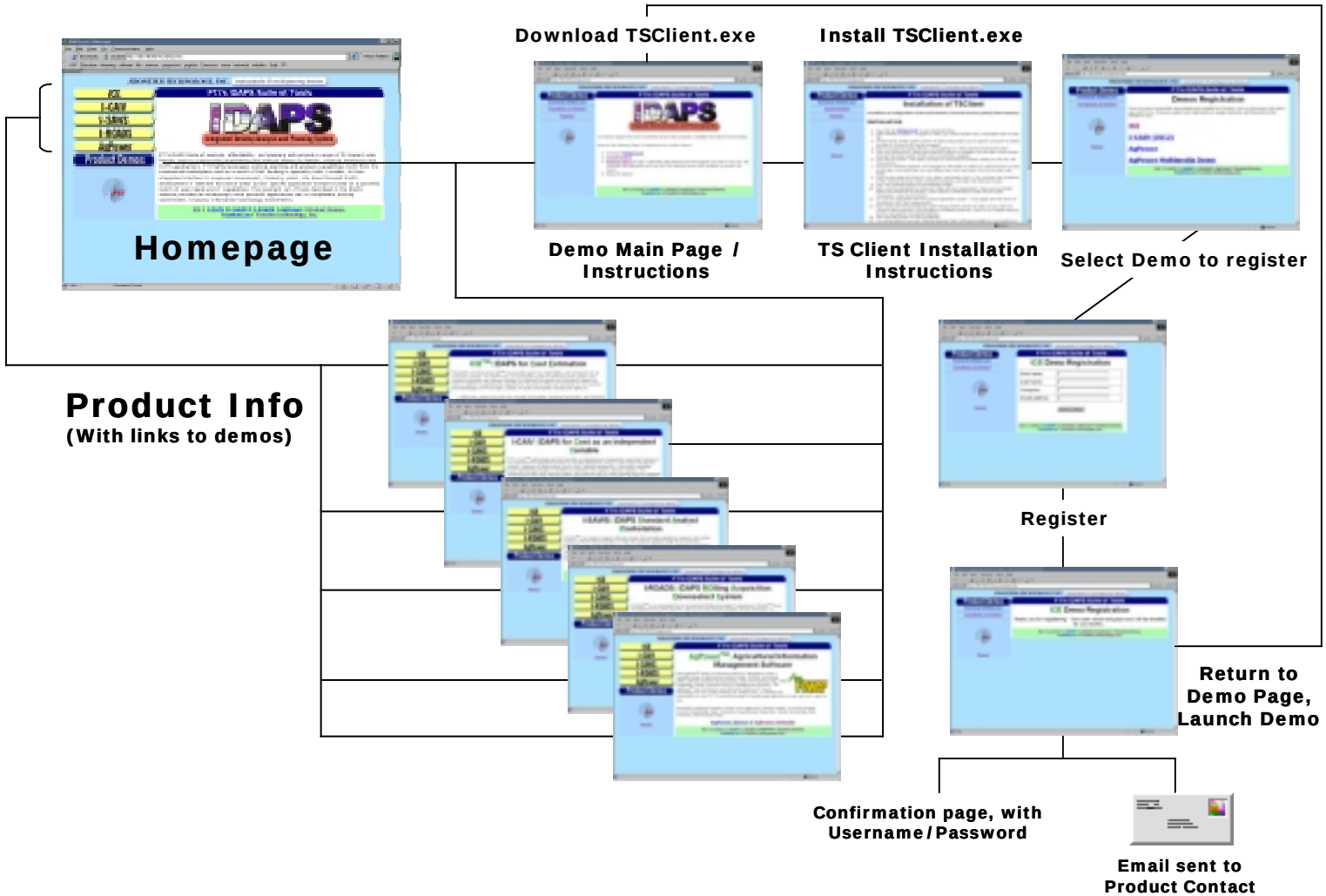
Applications Include: SATCOM & SATOPS Arch. (NSSA), TMD COEA (BMDO), BMD Test Sensor Assess. (BMDO), TAMD Arch. Roadmap Study (BMDO/JTAMDO), NMD Pre-LSI Study (UMDC), SBL Arch & Afford. Study (TRW), …



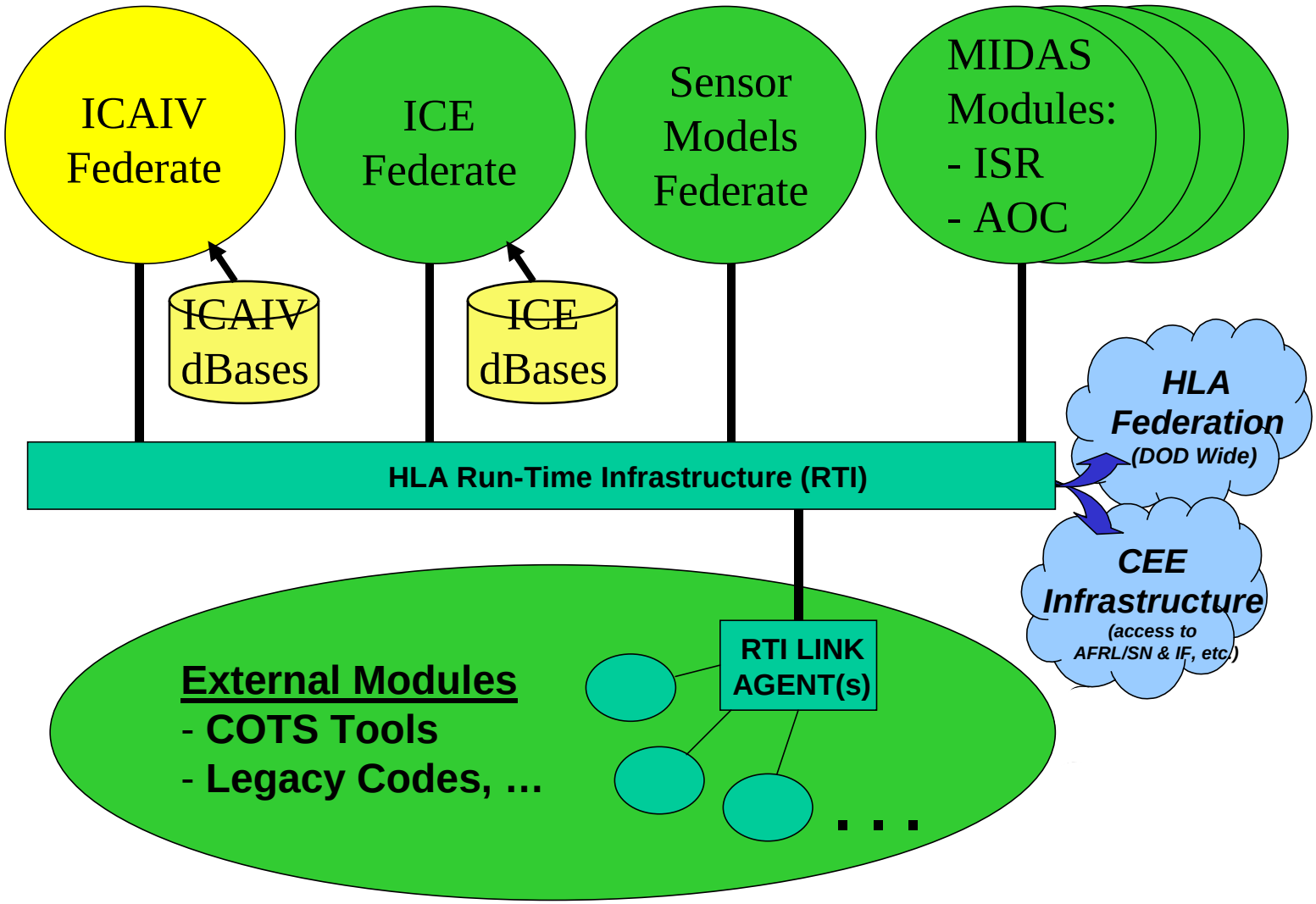
I-CAIV Evolution to a Web-Enabled Tool

- IDAPS Home Page Access via MS Terminal Services -

IDAPS.com Website Flow



IDAPS HLA Integration Approach
- I-CAIV Evolution to Add HLA Compliance -

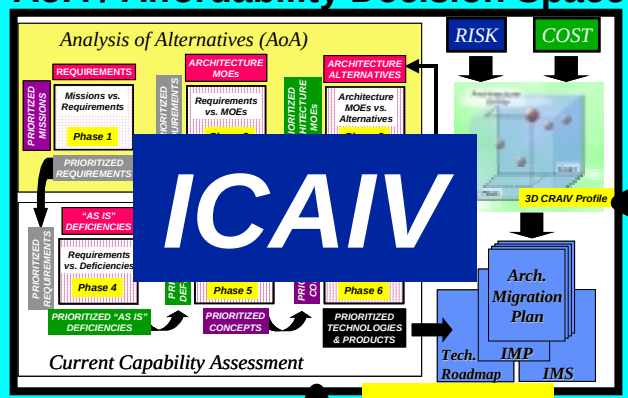


FTI's I-CAIV Process and Tool
- Summary -

- **Comprehensive Analytical Environment for Assimilating the Growing Complexity of Analytical Data**
- **Requirements Analyses and Prioritization That Establishes Warfighter Needs and Traces These Needs Thru CAIV Results**
- **Consistent Standard for Establishing and Weighting MOEs According to How Strongly They Correlate to Requirements**
- **Architecture Utility Scores Support CAIV Sensitivity Analyses and Provide Decision Makers With Best Options at a Given Cost**
- **Provides a Framework Supporting Technology Investment Strategy Determination … Assess Tech. Impacts on Arch. Alt. CAIV Results**
- **COTS-Based IT Automation Brings Host of GUI-Driven Features For Data Access, Integration, Manipulation, Visualization, and Control**

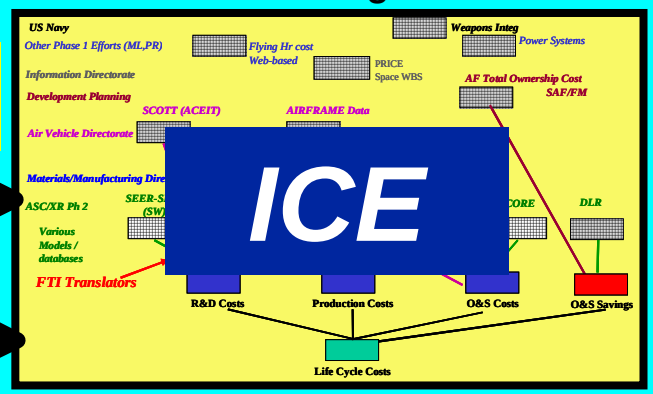
IDAPS + STK Forms an Integrated Tool Suite For End-to-End Analysis Execution

AoA / Affordability Decision Space

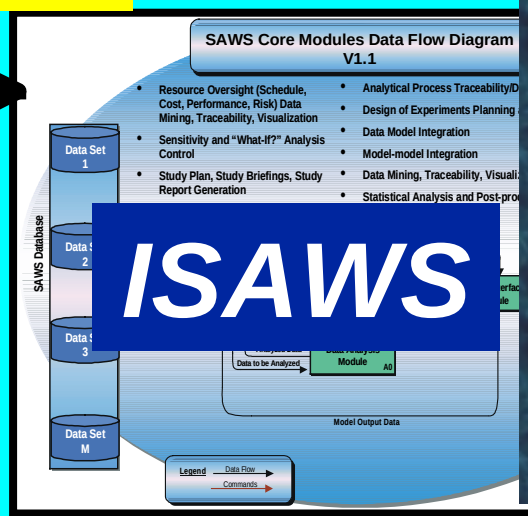


Cost Analysis Results

Cost Modeling / RTOC



Analysis Results



Turn-Key Analysis Environment

AGI's Satellite Tool Kit (STK)

AGI and FTI Teaming to Design an Integrated Analysis Envir. For Space

FTI's IDAPS Suite of Automated Tools
- Points of Contact -

Integrated Desktop Analysis and Planning System

IDAPS™

ICE™

Ron Shroder, Director, Dayton Operations
(937) 429-3302 x22, Email: rshroder@dayton.fti-net.com

ICAIV™

Mike VonPlinsky, Director, Systems Engr. Operations
(805) 685-6672 x123, Email: mvp@sb.fti-net.com

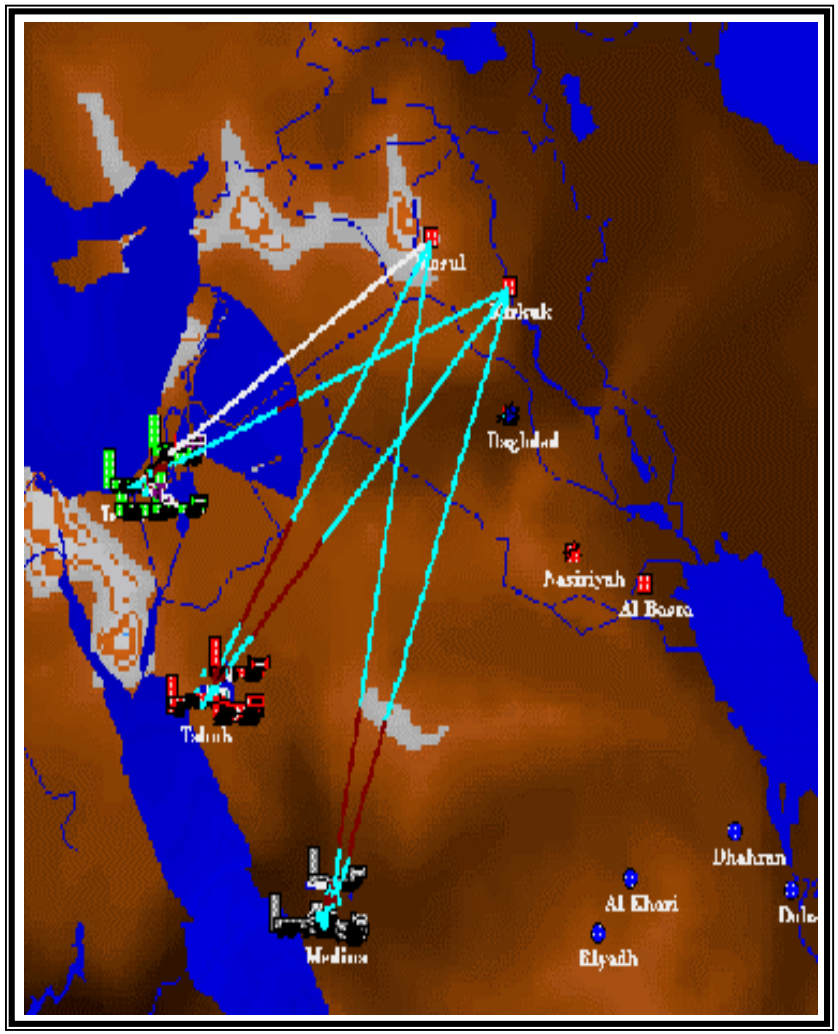
ISAWS™

Ed Crowder, Director, Washington DC Operations
(703) 671-0508 x23, Email: ecrowder@dc.fti-net.com

IROADS™

Mike VonPlinsky, Director, Systems Engr. Operations
(805) 685-6672 x123, Email: mvp@sb.fti-net.com

TMD COEA I-CAIV



Customer: BMDO / AQI

Period of Performance: Oct. 95 - Dec. 96 (~$400k)

Objective:

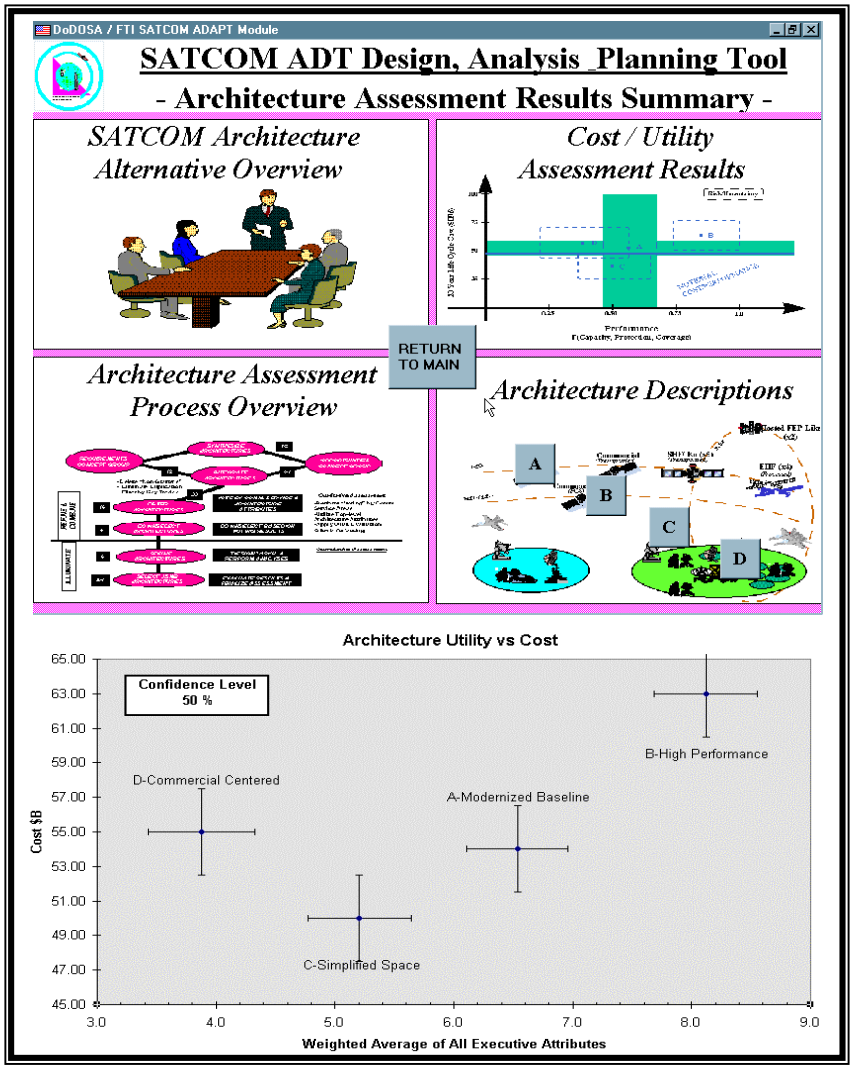
- Demonstrate Methodology to Support TMD Architecture Assessments Using Both Qualitative and Quantitative MOEs in a Common Decision and Analysis Framework
- Build Prototype Automated Environment to Analyze Various Architecture Alternatives
- Integrating COEA Results Across All Pillars

Accomplishments:

- Delivered Prototype Tool … It's Success Led to:
  - Enhancements to Add Attack Ops. Module & Integrate COEA / Other Related Results in Tool
  - Seminar With UK BMD SCORE Team … Agreed to Use Process / Tool for TMD Study.
- Developed TMD AD/AO Force Mix Study (TAFMS) Plan in Concert With UK BMD Analysis Objectives … Awaiting UK Side Funding to Start

National Security Space Architect

- Architecture Development Team (ADT) Support -



PoP: Jan '96 – Dec '97 (~$450k)

OBJECTIVES:

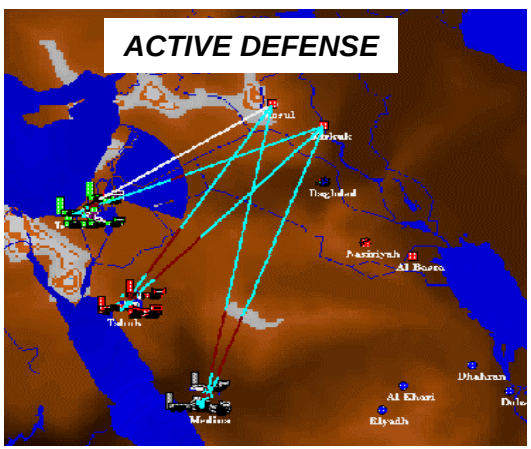
- Assess Alternative Architectures for Major Functional Areas of Space (Comm, Sensing,…)
- Suggest Viable Architecture Alternatives to the JSMB Based on Cost and Performance Trades

ACCOMPLISHMENTS:

- Implemented Tailored Architecture Assessment Process for SATCOM & SATOPS Architecture Assessments
- Developed Cost / Benefit Profiles Using Integrated Assessment & Analysis Results
- Key Contractor to Aid Gov't in Analysis Planning and Integration Into Assessment Process
- Captured Results in Automated Tools
  - IDAPS & AIE

TMD AD/AO Force Mix Study (TAFMS)

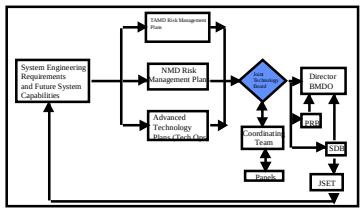
- **US / UK TMD Active Defense / Attack Operations Force Mix Study**
  - **Evaluate "Balance of Investment" Issues Between AD & AO**
  - **Analyze From a TMD Perspective AND As Force Allocations Impact Other Missions In-Theater**
  - **Estimate "Opportunity Costs" Associated With Employing Increments of Active Defense & Attack Operations Forces**
- **Leverage QFD Methodology and Automated Analysis* Correlation Framework to Capture, Organize, and Integrate Study Results**



via IDAPS: Integrated Desktop Analysis and Planning System

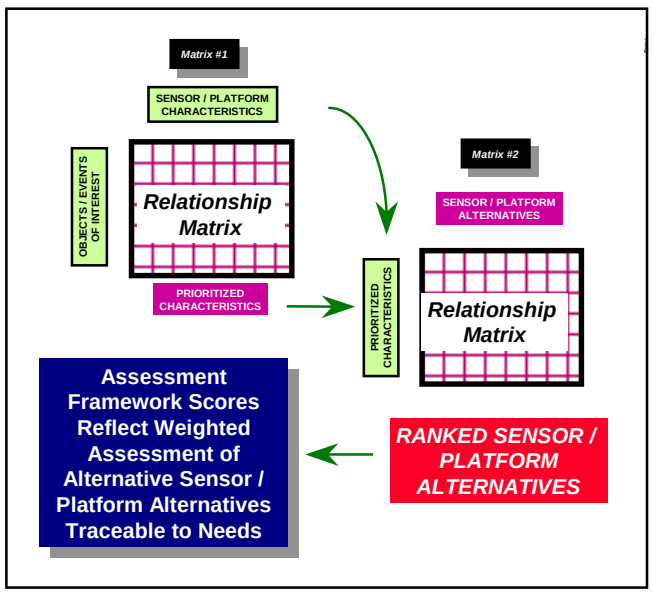
FTI Technology / Test Resource Assessment Process via I-CAIV

AST

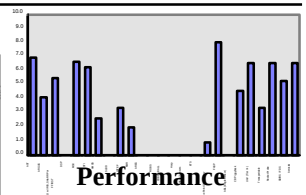


BMDO Systems Technology Process

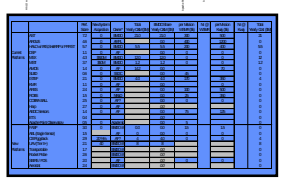
HALO



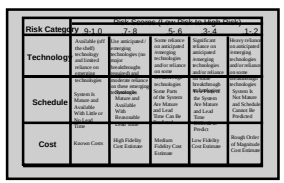
FTI Technology / Test Resource Assessment Process



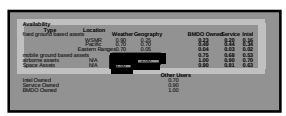
Performance



Cost



Risk



Availability

CUSTOMER: BMDO / DE (Dr. R. Bleach)

PERIOD OF PERFORMANCE:

PHASE I: JAN - MAR 97
PHASE II: APR - OCT 97

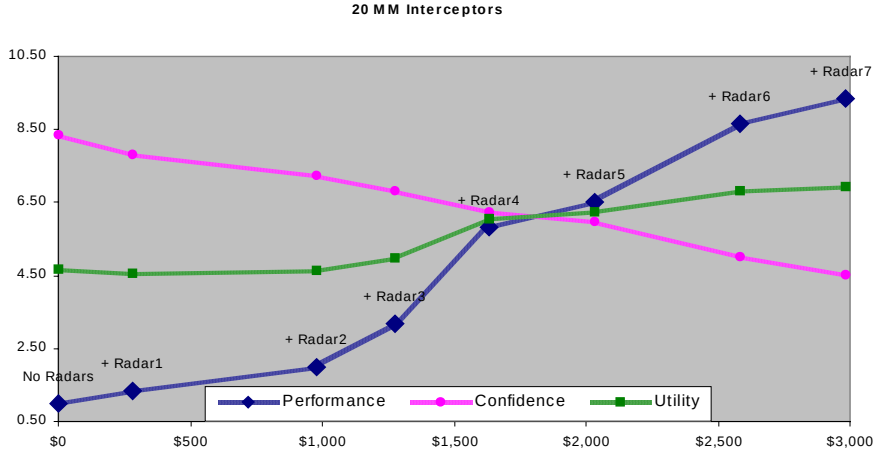
PHASE I OBJECTIVES:

- **Tailor FTI Assessment Process / Tool to Technology / Test Resource Application**
- **Demonstrate Utility of Process / Tool in Evaluation of IR Sensor Platforms for BMD Test Support**

ACCOMPLISHMENTS:

- **Process / Tool Quickly Applied to IR Sensor Evaluation**
  - **Accepted by Community As Attractive Approach**
- **Tool Provided Highly Flexible and Dynamic Data Integration, Assessment, Visualization, and Archival Framework**
  - **Allows "What-Ifs" on Key Attributes (User Needs, Performance, Cost, Risk)**
- **Successfully Used to Evaluate Numerous IR Sensor Test Support to Support BMDO Investment Decisions**

NMD Concept Development Support



Criteria	Weights		No Radars	+ Radar1	+ Radar2	+ Radar3	+ Radar4	+ Radar5	+ Radar6	+ Radar7
Performance	1.00		1.00	7.83	5.83	8.67	2.67	5.17	6.50	4.83
Coverage @ xx% Pneg		0.50	1–Low coverage	10–Great Salvo; xx% SLS	6–xx% Salvo; xx% SLS	7–xx% Salvo; xx% SLS	3–xx% Salvo; xx% SLS	6–xx% Salvo; xx% SLS	6–xx% Salvo; xx% SLS	4–xx% Salvo; xx% SLS
Threat Adaptability		0.50	1–No radars.	6–Some XBRs; UEWR	6–Few XBRs; Few UEWRs	10–Lots of XBRs; Some UEWRs	2–UEWRs only	4–XBR only; UEWRs	7–Few XBRs; few UEWR	6–Some XBRs; UEWR
Confidence (1/Risk)	1.00		8.4	6.2	5.1	2.4	6.8	5.9	4.7	6.4
Technical		0.33	8–No radars. Deployment at single location.	6–UEWR software development; XBRs	6–UEWR software development double upgrade (hardening); XBRs	4–UEWR software development; XBRs, one L-band radar	6–UEWR software development required; double upgrade (hardening)	6–UEWR software development; double upgrade (hardening), XBR	6–UEWR software development ; double upgrade (hardening); XBRs	6–UEWR software development; XBRs
Schedule		0.33	9–No radars. Deployment at single location	7–More XBRs	6–Double upgrade (hardening), XBRs at difficult locations	2–Large Number XBRs, one L-band radar; and GBI in difficult locations	8–UEWR software development required; double upgrade (hardening)	7–UEWR software development; double upgrade (hardening); 1 XBR	6–UEWR software development ; double upgrade (hardening); XBRs	7–UEWR software development; 3 XBRs at difficult locations
Programmatic		0.33	8–GBI at difficult location. Treaty Concerns.	6–GBI at different location. Treaty Concerns.	3–Higher cost architecture. GBI at difficult location. Treaty Concerns. UEWR	1–Very high cost architecture. GBI at difficult location. Treaty Concerns. Foreign radar deployments	6–GBI. Treaty concerns.	4—UEWR at difficult locations. Treaty concerns.	3–Higher cost architecture. Treaty concerns. UEWR at difficult location.	6–Treaty concerns.
Weighted Average (Utility)			4.7	7.0	5.5	5.5	4.7	5.5	5.6	5.6
Pneg - 20 Interceptors										
3 Salvo Minimum			0.9700	0.9750	0.9800	0.9850	0.9900	0.9950	0.9970	0.9980
Life Cycle Cost ($M)			$0	$282	$980	$1,273	$1,632	$2,030	$2,582	$2,982

Customer: BMDO (UMDC) ($373k)

Period of Perf.: June 1997- March 1998

Objective: NMD System Concept Development (CD) Support (pre-LSI Phase)

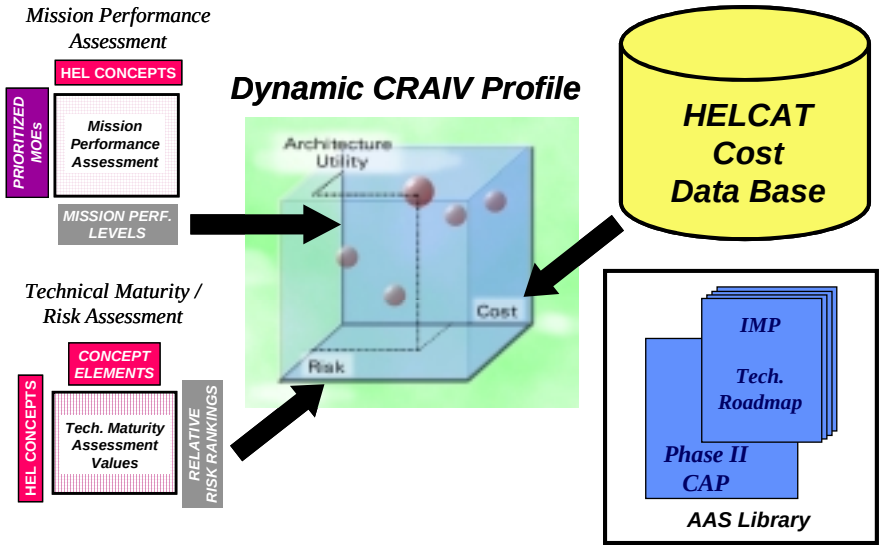
Accomplishments:

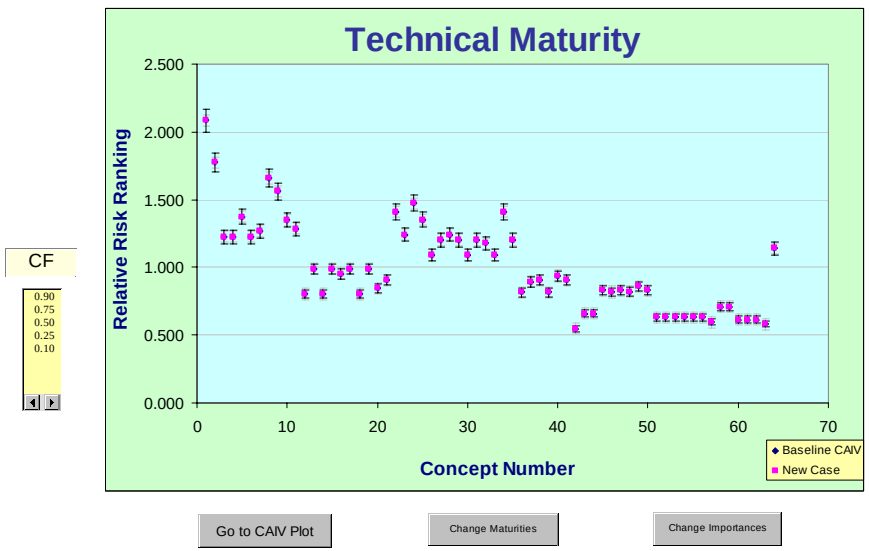
- **Architecture Synthesis and Analysis (KKV Interceptor and System)**
- **Cost as an Indep. Variable (CAIV)**
- **Requirements Flowdown/Traceability**
- **Risk Assessment and Mitigation**
- **Test Planning/Critical Issue Res. Tracking**
- **Architecture Treaty Assessment**

Automated Tools Developed:

- **Legacy to Integrated Desktop Analysis and Planning System (IDAPS)**
  - » NMD Analysis and Planning Tool (NAPT)
  - » NMD Risk Integration Tool (NRIT)
  - » GBI Alternatives Evaluation Tool (GAET)

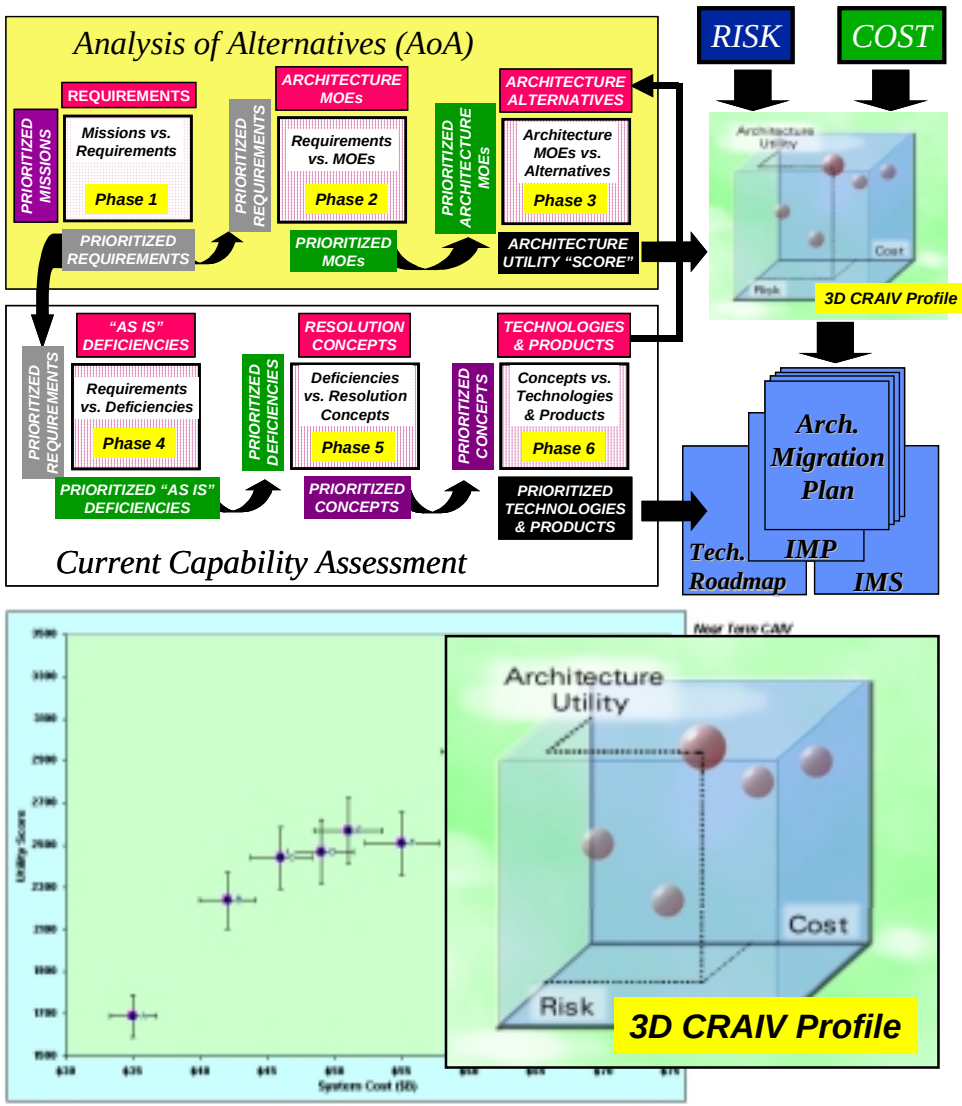
I-CAIV for Space Based Laser (SBL) Architecture & Affordability Study (AAS)





- **Customer**: TRW Space & Electronics (Redondo Beach) for AF/SMC and BMDO Joint Study
- **Objective**: Provide I-CAIV Tool Environment for SBL AAS
- **Scope**: Implement visible I-CAIV into for Phase IB deliverables
- **Period of Perf.**: 6/1/99 - 9/24/99
- **Contract Value**: $125k / Phase IB
- **Achievements**:
  - Successfully captured Technical Maturity data and developed Alternatives 'what-if' tradespace
  - Developed IDEF 0 Process Flow for SBL Arch. AoA Analysis
  - FTI Tool used in General Officer Steering Panel brief

IDAPS* for Cost as an Independent Variable - ICAIV -



Customers:

- BMDO (TMD & NMD)
- Nat. Security Space Arch. (NSSA)
- SBL Study (SMC & BMDO)
- Industry (TRW, LMC, ITT, UMDC, …)

Gov't / Industry Invest. To-Date: >$1M

Capabilities Overview:

- Disciplined Systems Engr. Process for Analysis of Alternatives (AoAs)
- Process Automated via PC-Based, Web-Enabled Tool
- Output is Decision Space for Cost / Benefit and RTOC Analysis
  - CAIV Profile … Utility vs. Cost
  - Add Risk for 3-D "CRAIV" Profile
- Tool Supports What-If / Sensitivity Analysis Dynamically in CAIV Profile
- Application Also Serves as Data Archive / Warehouse

*IDAPS: Integrated Desktop Analysis and Planning System

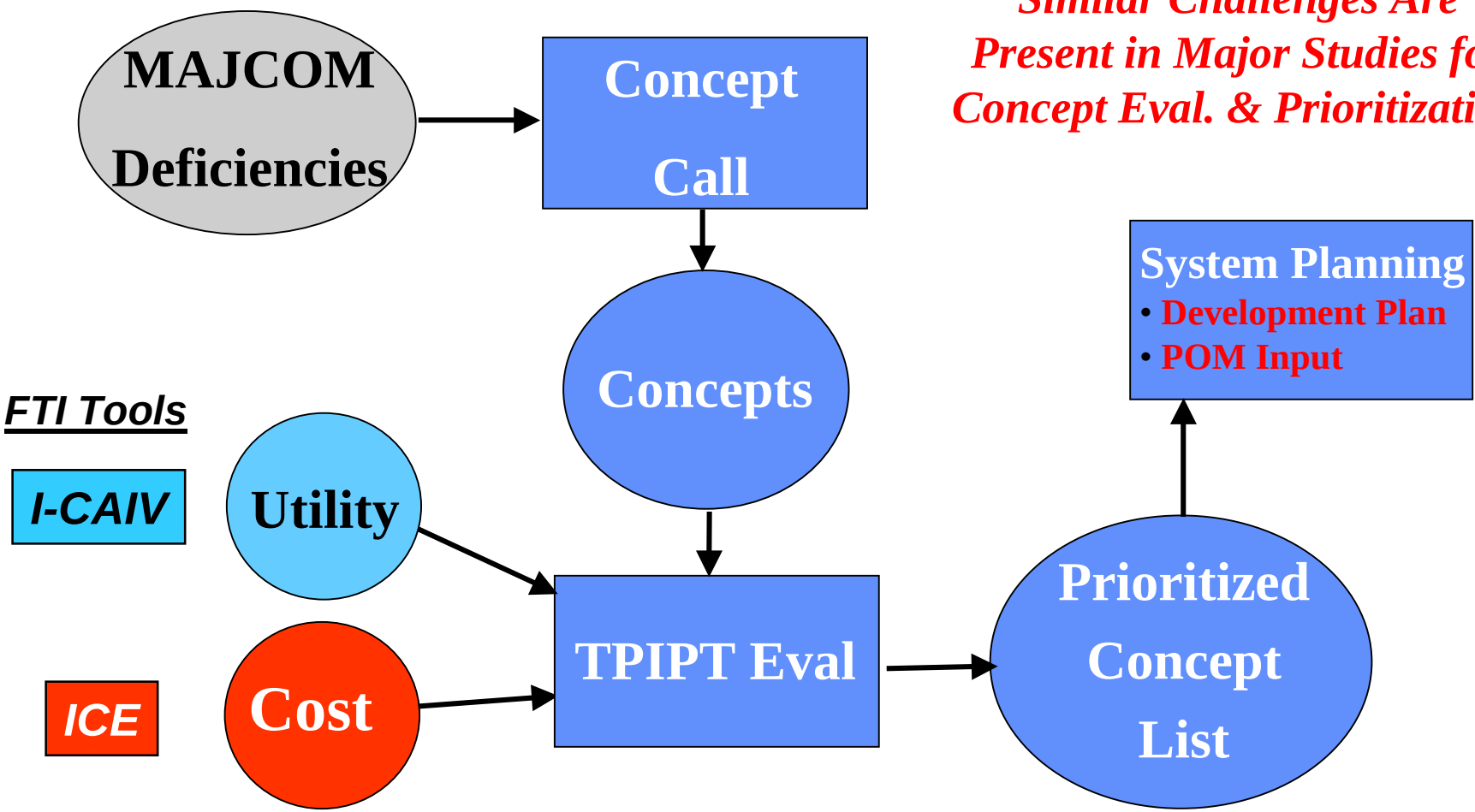
Basic ICE Development

Integrated Desktop Analysis and Planning System (IDAPS) for Cost Estimation

(I C E)

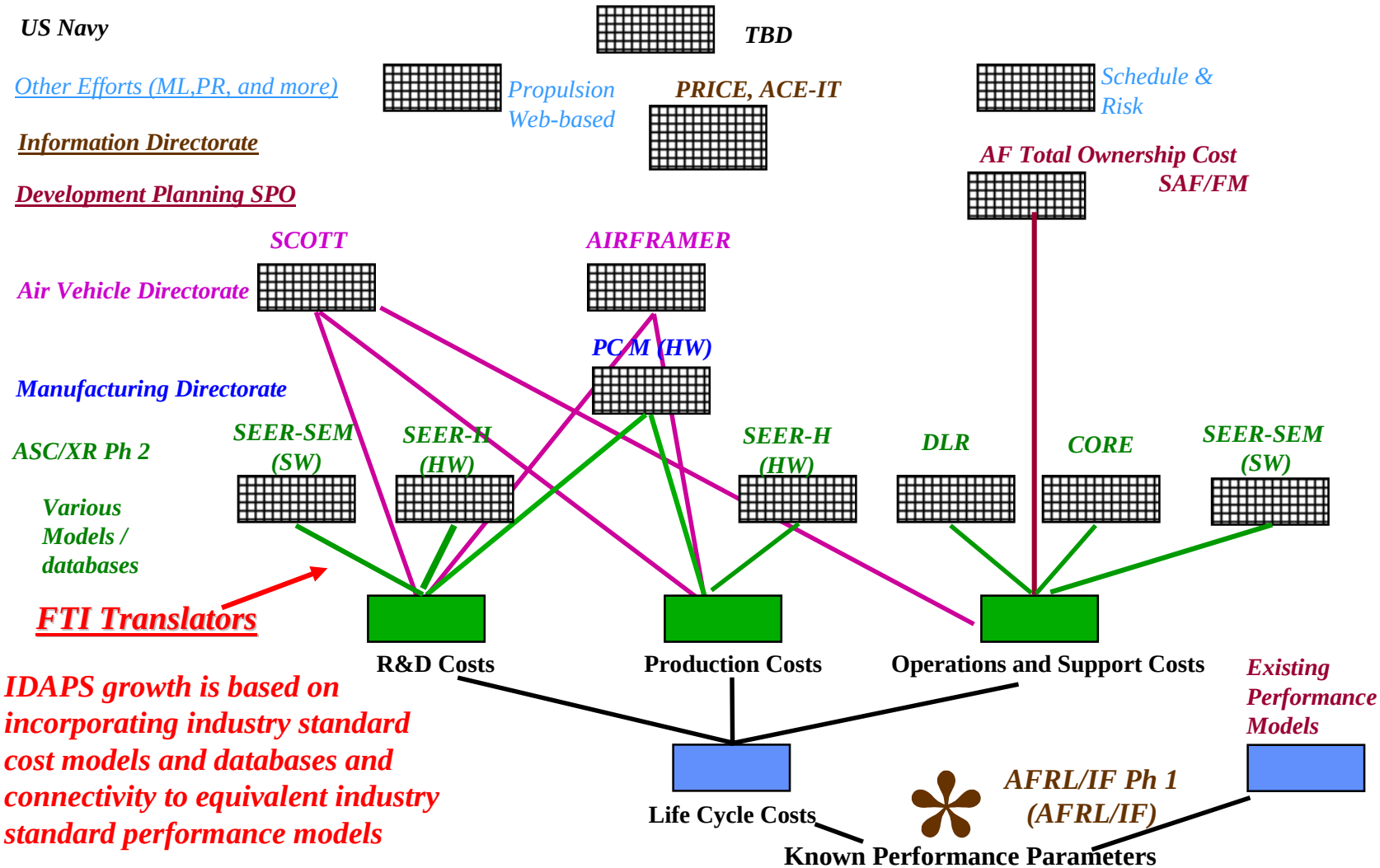
- **Developed for the AF ASC/XR Deputy for Development Planning … Under a Phase II SBIR**
- **Initially Developed to Assist TPIPT Process ... Quickly Estimate the Costs of Hundreds of Concepts as Part of Concept Call Cycle**

TPIPT Implementation of AF Modernization Planning Process



Similar Challenges Are Present in Major Studies for Concept Eval. & Prioritization

FTI's IDAPS for Cost Estimation (ICE)



IDAPS growth is based on incorporating industry standard cost models and databases and connectivity to equivalent industry standard performance models

ICE Cost Evaluation Capability History
- Continued Growth & Commercialization -